Hemodialysis Provision in West Java: A 2022 Profile

NASKAH ARTIKEL

Diajukan sebagai pemenuhan persyaratan gelar Sarjana
Fakultas Kedokteran
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UNIVERSITAS PADJADJARAN
FAKULTAS KEDOKTERAN
BANDUNG
2024

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Lembar ini untuk menyatakan bahwa kami telah memeriksa salinan proposal hasil karya penulis dengan nama di atas dan menyatakan telah layak untuk diajukan dalam Sidang Hasil Penelitian.

Kami merekomendasikan nama berikut sebagai penguji:

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dan telah berkomunikasi dengan nama-nama di atas dan menyepakati untuk dilakukan ujian usulan penelitian terhadap mahasiswa tersebut dengan cara (sidang / ~~desk evaluation~~) pada tanggal 9 Januari 2025

Bandung, 23 Desember 2024

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ABSTRAK

Aim

Discrepancy between the needs and access to kidney replacement therapy (KRT) is a worldwide problem. Shortages of hemodialysis (HD) nurses, machines, and attending physicians in Indonesia, the world's fourth most populous country, result in inadequate HD. Data on provision is crucial for improvements; current reports publish national aggregates, but data on a more specific scale is needed. This study aimed to describe regency/city-level HD provision in West Java in 2022.

Methods

158 HD centres with complete information on new and active HD patients, attending physicians, nurses and machines for the period January-December 2022 were reviewed from the Indonesian Renal Registry (IRR) database. Incidences, prevalences and densities were calculated using population numbers from the West Java Central Bureau of Statistics. Comparisons were made with predicted values from a previous study.

Results

Of the 27 cities/regencies, 1 (Pangandaran Regency) had no HD centre. West Java HD incidence and prevalence were 232 pmp (131% from predicted) and 346 pmp (40%). Densities were as follows: adult nephrologists (0.3 pmp), HD-certified internists (2.1 pmp), all nurses (37 pmp, 30% from predicted), certified nurses (27 pmp), machines (58 pmp, 40% from predicted).

Conclusion

More efforts by administrative authorities and the Ministry of Health are needed to increase the number of training centres and their ease of access for specialists and nurses, as well as better distribution of these workforces.

KATA PENGANTAR

Puji dan syukur kepada Allah SWT. yang berkat pertolongan, rahmat, dan kasih sayang-Nya peneliti dapat menyusun naskah artikel yang berjudul *"Hemodialysis Provision in West Java: A 2022 Profile"* ini. Shalawat dan salam kepada Rasulullah SAW. Yang senantiasa menjadi teladan bagi umat manusia.

Penyakit ginjal kronis (PGK) merupakan tantangan global maupun nasional yang membutuhkan upaya terus menerus untuk mengevaluasi dan mengembangkan kebijakan untuk menanggulanginya. Indonesian Renal Registry (IRR) telah berdiri sejak tahun 2007 sebagai pusat data untuk tujuan tersebut. Untuk mengembangkan lebih lanjut manfaat data nasional IRR, peneliti tertarik untuk memperkecil skala laporan data dari IRR pada tingkat kabupaten/kota di Jawa Barat. Peneliti berharap data yang disajikan dapat membantu pemangku kebijakan khususnya pada tingkat kabupaten/kota untuk mengevaluasi dan mengembangkan kebijakan yang lebih efektif untuk menghadapi kasus PGK dan kebutuhan dialisis di Jawa Barat.

Atas dukungan dan bantuan yang diberikan selama peneliti menyelesaikan penelitian ini, peneliti dengan penuh hormat mengucapkan terima kasih dan mendoakan semoga Allah memberikan balasan terbaik kepada:

- Mursyid Hasan Basri (ayah), Deris Ristiana (ibu), Aina Hikari Hasan Basri (adik) selaku keluarga peneliti.
- Dr. Yuni Susanti Pratiwi, dr., M.Kes, selaku Ketua Program Studi Sarjana Kedokteran Universitas Padjadjaran.
- Dr. Afiatin, dr., Sp.PD-KGH dan Dr. Yulia Sofiatin, dr., SpPD, selaku pembimbing peneliti dalam menyusun penelitian.
- Para dosen pengajar Fakultas Kedokteran Universitas Padjadjaran.

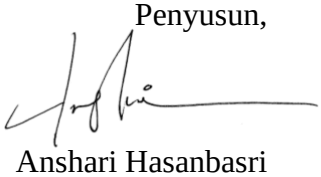
Terima kasih juga peneliti haturkan kepada semua pihak yang telah membantu peneliti dalam menyusun penelitian ini yang tidak dapat peneliti sebutkan satu per satu.

Akhir kata, peneliti menyadari bahwa tidak ada yang sempurna dan mungkin masih terdapat kekurangan dalam penyusunan penelitian ini. Oleh karena itu, peneliti memohon maaf atas kekurangan yang dilakukan peneliti.

Peneliti berharap semoga penelitian ini dapat bermanfaat bagi pihak-pihak terkait. Kebenaran datangnya dari Allah dan kesalahan datangnya dari diri peneliti. Semoga Allah SWT. senantiasa melimpahkan rahmat dan rida-Nya kepada kita semua.

Bandung, 23 Desember 2024

Penyusun,



Anshari Hasanbasri

1. Introduction

Hemodialysis (HD) is a mode of kidney replacement therapy (KRT) for people with chronic kidney failure, also known as stage 5 chronic kidney disease (CKD5).[1] Approximately 10% of the world's population have CKD (of any stage), many progressing to CKD5 (0.1% of world population).[2] Kidney failure morbidity and mortality depend greatly on the quality of treatment.[2] However, there is a concerning discrepancy between the need for and access to KRT worldwide. It was estimated that in 2010 there were 2.3 million (47%) to 7.1 million (73%) CKD5 patients needing but having no access to KRT, leading to over 2 million premature deaths. The number is projected to be about 9.1 million (63%) in 2030.[3] Of those needing KRT, only 4%, 10%, 30% and 60% have access to it in low, lower-middle, upper-middle and high-income countries, respectively.[4]

Indonesia, the world's fourth most populous country with almost 280 million people, is also Southeast Asia's largest economy and ranks as the 16th largest globally in terms of Gross Domestic Product (GDP).[5,6] The global "supply-demand" gap of KRT provision is reflected in Indonesia through shortages of nurses, machines and attending physicians for HD.[7] The resulting compromise in capacity and quality of care is stark: in 2018, only 48% (n = 7,001) and 52% (n = 11,531) of the estimated minimally required number of HD nurses and machines, respectively, were available.[8] As a result, in West Java, Indonesia's most populous province, the available facilities can only optimally serve 49.9% of the patients.[9] In 2020, 86% of patients in Indonesia did not attain targeted Kt/V, the most important adequacy parameter for HD.[7]

The availability of relevant data is necessary to improve HD provision. Indonesian Renal Registry (IRR) has been documenting the country's profile of dialysis care since

2007, but so far their annual reports have only had data on national aggregates. However, Indonesia is an archipelago with a vast sociocultural diversity. More specific information, for example on the level of regencies/cities in West Java province, the country's most populous (17.92%)[10] province, would therefore provide more specific insights for relevant authorities to make improvements. This study seeks to do exactly that: to describe and elicit insights from HD provision profile in West Java according to the latest available data (2022).

2. Materials and methods

2.1 Study design

This was a descriptive study on the profile of HD provision, including the number of HD centres, new and active patients, attending physicians, nurses and machines in regencies and cities of West Java. The data was provided by the Indonesian Renal Registry (IRR) database for the period January to December 2022 (the latest available and verified). This study was approved by the ethics committee of Universitas Padjadjaran.

2.2 Subjects

All subjects (individual HD centres registered in the database) with complete information on the variables studied were included. The author requested and received tables of data needed from IRR. Information on the population number of each regency/city was acquired from the West Java Central Bureau of Statistics (*Badan Pusat Statistik*)[11] and used to calculate incidences, prevalences and densities.

2.3 Definitions

Specific terms used throughout this study are defined as follows:

- A *new HD patient* is a person undergoing HD for the first time in 2022.[12]

- An *active HD patient* is a person undergoing HD in 2022 irrespective of the year the HD was started and is alive by 31 December 2022.[12]
- An HD centre is a facility providing HD service as defined by the Guideline of Dialysis Service in Healthcare Facilities (*Pedoman Pelayanan Dialisis pada Fasilitas Pelayanan Kesehatan*).[13]
- An *HD attending physician* (*dokter penanggung jawab pelayanan [DPJP]*) is an adult nephrologist (*dokter spesialis penyakit dalam konsultan ginjal-hipertensi [Sp.PD-KGH]*) or a general internist (*Sp.PD*) certified in basic dialysis provision as issued by the Indonesian College of Internal Medicine who oversees HD provision in an HD centre.[13]
- A *certified nurse* is a nurse who has acquired certification of competence for dialysis care as issued by training centres accredited by the Ministry of Health and under the recommendation of the Indonesian Society of Nephrology (PERNEFRI).[13]
- A *machine* refers to an HD machine.

3. Results

A total of 158 HD centres in West Java were included in this study. Information on all other variables (the number of patients, attending physicians, nurses and machines) was as submitted by participating centres into the IRR database. These information are presented at regency/city-level in Tables 1, 3 and 4.

No HD centre was documented in Pangandaran Regency. Thus information on the number of patients, attending physicians, nurses and machines in this area were not readily available. The regency was formed in 2012 out of Ciamis Regency (formed in 1950).[14] With half its perimeter being a coastal area and its other half adjacent to Ciamis

Regency and Tasikmalaya Regency, it was only populated by one-third that of Ciamis Regency.[11] Considering these and geographical proximity, HD patients residing in Pangandaran Regency may likely undergo HD in (and thus were registered under) centres in neighbouring regencies.

4. Discussion

The overarching theme of the current study is the "supply-demand" gap between people needing and receiving HD in West Java. This study focuses on HD as it is the main KRT modality; the number of active peritoneal dialysis [PD] patients is only 2% of that of HD and 1% for new patients,[7] while data on transplant is not yet as comprehensively documented.

4.1 Incidences and prevalences of HD patients: the quest for unmet needs

Incidence and prevalence in West Java as a whole (232 and 346 pmp, respectively) (Table 1), rather than the median values of the 26 available areas, might be slightly more representative since the former includes the population of the area with unavailable data but whose HD patients may be reflected in the neighbouring regencies' numbers. This is higher than the national incidence (229 pmp, in 2020) but lower than the national prevalence (485 pmp, in 2020).[7,10]

(continued)

Table 1. Incidences and Prevalences of HD Patients According to Centres

Regency/City	Population	N			HD Centre Density (pmp)	HD Incidence (pmp)	HD Prevalence (pmp)
		HD Centres	New HD Patients	Active HD Patients			
Bandung Barat Regency	1.846.969	2	67	66	1	36	36
Bandung City	2.461.553	18	2323	3498	7	944	1421
Bandung Regency	3.718.660	4	323	720	1	87	194
Banjar City	206.457	2	93	174	10	450	843
Bekasi City	2.590.257	21	1160	1638	8	448	632
Bekasi Regency	3.214.791	10	605	834	3	188	259
Bogor City	1.063.513	10	390	636	9	367	598
Bogor Regency	5.566.838	11	781	1020	2	140	183
Ciamis Regency	1.247.768	2	212	150	2	170	120
Cianjur Regency	2.542.793	1	160	126	0,4	63	50
Cimahi City	575.235	5	274	582	9	476	1012
Cirebon City	341.235	4	368	516	12	1078	1512
Cirebon Regency	2.315.417	5	568	1038	2	245	448
Depok City	2.123.349	14	345	924	7	162	435
Garut Regency	2.627.220	3	187	462	1	71	176
Indramayu Regency	1.871.832	5	424	510	3	227	272
Karawang Regency	2.505.247	14	457	942	6	182	376
Kuningan Regency	1.196.017	5	291	570	4	243	477
Majalengka Regency	1.335.460	3	367	372	2	275	279
Pangandaran Regency	432.380	0	N/A	N/A	0	N/A	N/A
Purwakarta Regency	1.028.569	5	525	426	5	510	414
Subang Regency	1.624.386	2	107	222	1	66	137
Sukabumi City	356.410	1	339	258	3	951	724
Sukabumi Regency	2.806.664	3	120	330	1	43	118
Sumedang Regency	1.167.033	3	336	300	3	288	257
Tasikmalaya City	733.467	4	448	678	5	611	924
Tasikmalaya Regency	1.906.288	1	197	84	1	103	44
West Java	49.405.808	158	11467	17076	3	232	346
Median across regencies/cities		4	339	510	3	227	279

Three areas with the highest incidences were Cirebon City (1078 pmp), Sukabumi City (951 pmp) and Bandung City (944). The lowest incidences were found in Bandung Barat Regency (36 pmp), Sukabumi Regency (43 pmp) and Cianjur Regency (63 pmp). As for prevalence, Cirebon City (1512 pmp), Bandung City (1421 pmp) and Cimahi City (1012 pmp) had the highest values. Bandung Barat Regency (36 pmp), Tasikmalaya Regency (44 pmp) and Cianjur Regency (50 pmp) had the lowest prevalences.

Comparison with other countries may provide hints on undocumented needs. In 2022, incidences in West Java, Brazil, Malaysia, Thailand, Europe and the UK are 232

(Table 1), 214[15], 238[16], 181[17], 152[18] and 154[19] pmp, respectively. Prevalences in those regions are, in the same order: 346 (Table 1), 758[15], 1378[16], 1203[17], 1074[18] and 1323[19] pmp. While the incidences are comparable, West Java's prevalence is starkly lower. This might mean that while centres can screen and initialise HD fairly well, they were unable to maintain routine provision for all patients, leading to deaths or lost-to-follow ups hence the low prevalence.

Comparison can also be made with predicted values. Afiatin (2020) predicted the incidences and prevalences of HD patients in West Java across 2019-2028.[9] According to the study, point-estimate incidence and prevalence in 2022, respectively, are 177 and 869 pmp. These numbers were multiplied by the population of each regency/city to find the predicted numbers of new and active patients in the corresponding area, which were then compared with the documented numbers (Table 2). Columns on the right show "data coverage" i.e. percentages of the number of documented patients out of the predicted values. Larger undocumented (missing) data, representing unmet needs, is to be suspected the smaller the percentage values are. West Java's prevalence coverage of 40% (Table 2) aligns with its low prevalence compared to other countries as discussed previously. The incidence coverage of 131% (Table 2, also see Figure 1) might be because Afiatin's prediction model was based only on survival rates from 2007-2018, which did not take into account the recent surge in healthcare funding and new HD centres around 2018 onwards as an effect from the increasing coverage of National Health Insurance (hence HD incidence doubled for the first time in 2018).[8,9]

It should be noted that the IRR database (for the period 2007 to 2018) was also used for the prediction study, with the inclusion criteria of "all individuals diagnosed with CKD5 in West Java with documented date when starting dialysis".[9] This means the data

used to train and test the models relied on numbers reported by participating HD centres, not different from the data for the current study. That said, because the data (and thus the prediction values) were provincial aggregates, it might not reflect possible regency/city-level differences. Further studies investigating prediction values on a regency/city level might thus offer additional insights.

(continued)

Table 2. Predicted Numbers and Data Coverage of New and Active HD Patients

	N (Predicted†)		Coverage (Documented : Predicted†)	
Regency/City	New Patients	Active Patients	New Patients	Active Patients
Bandung Barat Regency	327	1605	20%	4%
Bandung City	436	2139	533%	164%
Bandung Regency	658	3232	49%	22%
Banjar City	37	179	254%	97%
Bekasi City	458	2251	253%	73%
Bekasi Regency	569	2794	106%	30%
Bogor City	188	924	207%	69%
Bogor Regency	985	4838	79%	21%
Ciamis Regency	221	1084	96%	14%
Cianjur Regency	450	2210	36%	6%
Cimahi City	102	500	269%	116%
Cirebon City	60	297	609%	174%
Cirebon Regency	410	2012	139%	52%
Depok City	376	1845	92%	50%
Garut Regency	465	2283	40%	20%
Indramayu Regency	331	1627	128%	31%
Karawang Regency	443	2177	103%	43%
Kuningan Regency	212	1039	137%	55%
Majalengka Regency	236	1161	155%	32%
Pangandaran Regency	77	376	0%	0%
Purwakarta Regency	182	894	288%	48%
Subang Regency	288	1412	37%	16%
Sukabumi City	63	310	537%	83%
Sukabumi Regency	497	2439	24%	14%
Sumedang Regency	207	1014	163%	30%
Tasikmalaya City	130	637	345%	106%
Tasikmalaya Regency	337	1657	58%	5%
West Java	8745	42934	131%	40%
Median across regencies/cities	327	1605	117%	32%

† Derived from predicted West Java incidence and prevalence by Afiatin (2020)[9] multiplied by regency/city population.

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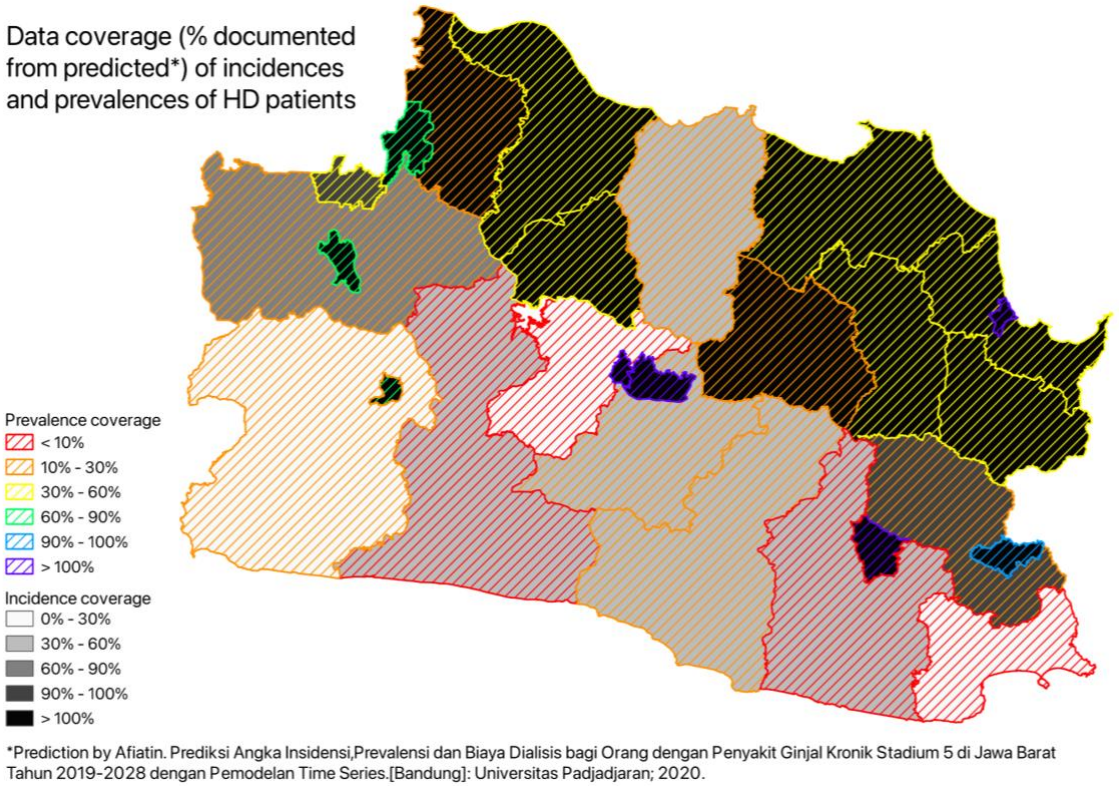


Figure 1. Map of data coverage (% documented from predicted) of incidences and prevalences of HD patients. *While only 9 (33%) of regencies/cities have incidence coverage of less than 90%, 22 (81%) have prevalence coverage of less than 90% (Pangandaran Regency is counted here since the fact remains that it has 0% coverage and that its portion might be shunted to neighbouring areas—that Tasikmalaya City has 345% incidence coverage might be telling.) (See Table 2 for values).*

Further studies may be needed to get a clearer picture of unmet needs aside from "data coverage" analysis such as the above. This includes mainly studies on the incidence and prevalence of CKD5 (while the Indonesian Health Survey 2023 has numbers on CKD of all stages[20], specifically stage 5 is not yet available). Studies on conservative kidney management (CKM) might also be informative, since CKM might be a preferable choice for elderly patients[2,21] and thus would also "free up" a portion of HD capacity. Another potentially insightful study is on the "HD waiting list" group. A person indicated for HD is only recorded as a "new HD patient" in the registry by the providing centre once they

have undergone their first HD session. Those prescribed but still on the "waiting list" to receive HD would therefore comprise a portion of undocumented needs.

Another major group in the "demand" side of HD provision is patients, whether new or not (only started dialysing that year or from prior) who have had access to HD but not as routinely as prescribed.[9] This might be a reason for the high rate of inadequate HD mentioned earlier. This is largely due to the number of nurses and machines, as they directly determine how many patients can be served in a centre; this will be discussed later.

Aside from incidence and prevalence, data on mortality is crucial to monitor the state of service. Malaysian Renal Registry offers a good example whereby numbers of new HD patients, deaths, transplanted, lost to follow-up and dialysing at 31st December ("active patients") were comprehensively documented.[16] It is thus possible to, among other things, check whether the numbers add up. Unfortunately, the lack of Indonesia's HD centres' participation in reporting data on deaths makes it impossible for the Indonesian Renal Registry to document mortality.[7] Further surveys on HD mortality (and perhaps, equally importantly, deaths amongst the "waiting list" population) would therefore be informative. While some efforts are underway, the present study focuses on just the incidence and prevalence.

4.2 Scarcity of ideal HD attending physicians and HD centres

An HD attending physician may simultaneously be in charge of a maximum of 3 HD centres. To avoid overlaps, the number of attending physicians in each regency/city in Table 3 refers to either attending physicians who were only in charge of one HD centre, or whose "primary" (largest) HD centre was in the corresponding area although they were also in charge of other centres (these "secondary" centres were not included in the column

on attending physicians, but included in HD centres column). Numbers and densities of HD centres and attending physicians are put side by side since the availability of both is tightly linked.

Table 3. Numbers and Densities of HD Centres and Attending Physicians

		N		Density (pmp)	
Regency/City	Population	HD Centres	Attending Physicians	HD Centres	Attending Physicians
Bandung Barat Regency	1.846.969	2	2	1	1,08
Bandung City	2.461.553	18	16	7	6,50
Bandung Regency	3.718.660	4	2	1	0,54
Banjar City	206.457	2	1	10	4,84
Bekasi City	2.590.257	21	17	8	6,56
Bekasi Regency	3.214.791	10	6	3	1,87
Bogor City	1.063.513	10	5	9	4,70
Bogor Regency	5.566.838	11	10	2	1,80
Ciamis Regency	1.247.768	2	1	2	0,80
Cianjur Regency	2.542.793	1	1	0,4	0,39
Cimahi City	575.235	5	4	9	6,95
Cirebon City	341.235	4	3	12	8,79
Cirebon Regency	2.315.417	5	3	2	1,30
Depok City	2.123.349	14	12	7	5,65
Garut Regency	2.627.220	3	3	1	1,14
Indramayu Regency	1.871.832	5	4	3	2,14
Karawang Regency	2.505.247	14	7	6	2,79
Kuningan Regency	1.196.017	5	4	4	3,34
Majalengka Regency	1.335.460	3	3	2	2,25
Pangandaran Regency	432.380	0	N/A	0	N/A
Purwakarta Regency	1.028.569	5	3	5	2,92
Subang Regency	1.624.386	2	1	1	0,62
Sukabumi City	356.410	1	1	3	2,81
Sukabumi Regency	2.806.664	3	3	1	1,07
Sumedang Regency	1.167.033	3	1	3	0,86
Tasikmalaya City	733.467	4	5	5	6,82
Tasikmalaya Regency	1.906.288	1	1	1	0,52
West Java	49.405.808	158	119	3	2,41
Median across regencies/cities		4	3	3	2,19

Three areas with the highest density of attending physicians are Cirebon City (8.79 pmp), Cimahi City (6.95 pmp) and Tasikmalaya City (6.82 pmp). Lowest densities are found in Cianjur Regency (0.39 pmp), Tasikmalaya Regency (0.52 pmp) and Bandung Regency (0.54 pmp).

While the capacity of an individual HD centre is determined by the availability of nurses and machines in that centre (the topic of the next section), attending physicians limit the number of available HD centres in the first place since a centre cannot operate without an attending physician. For example, Malaysia has 9 times the density of HD centres in West Java—at least 890 centres[16] (27 pmp) and 158 (3 pmp) (Table 1), respectively. As will be shown, this is likely due to the scarcity of HD attending physicians.

Attending physicians (*dokter penanggung jawab pelayanan [DPJP])* are adult nephrologists (*dokter spesialis penyakit dalam konsultan ginjal-hipertensi [Sp.PD-KGH]*) overseeing HD provision; if no adult nephrologist is available, then (general) internists who are certified in basic dialysis provision as issued by the Indonesian College of Internal Medicine may assume the position.[13]

As of 2022, according to direct information from the IRR in addition to the data provided for this study, there were only 15 (0.3 pmp) adult nephrologists and 104 (2.1 pmp) dialysis-certified internists in West Java. These were slightly lower than the national densities (0.4 pmp and 3.2 pmp in 2020, respectively).[7,10] To illustrate how small these numbers are, the median density of adult nephrologists in lower-middle-income countries was 1.64 pmp, with the lower interquartile range at 0.52 pmp.[2] Globally, North and East Asia had the leading density of 26.39 pmp.[2] The fact that, as mentioned earlier, an attending physician may be in charge of more than one HD centre also reflects this scarcity, especially those who are preferably adult nephrologists.

Serious shortages of specialists (including general internists) in Indonesia precipitate this scarcity of HD attending physicians. There are currently 49,670 specialists; with the ideal ratio of 0.28 specialists per 1000 population, Indonesia is short

of 29,179 specialists.[22] Training centres were also limited, reflected by the fact that since 2023, the government has been launching hospital-based (as an alternative to the conventional university-based) specialist training whereby designated hospitals can now independently provide equivalent training.[23] While other efforts such as public scholarships[24] have also been made to meet this demand, it might take a while before a satisfactory number of adult nephrologists are available to supervise more HD centres.

4.3 Shortages of nurses and machines

HD-certified nurses ("certified nurses") are nurses who have acquired certification of competence for dialysis care as issued by training centres accredited by the Ministry of Health and under the recommendation of the Indonesian Society of Nephrology (*PERNEFRI*).[13] "All nurses" encompasses both certified nurses and "yet to be" (uncertified) nurses (Table 4). These uncertified nurses may only temporarily provide dialysis care and must have been registered for upcoming training and certification proven by a letter of acceptance for the training.[13]

(continued)

Table 4. Numbers and Densities of All Nurses, Certified Nurses and Machines

		N				Density (pmp)			
Regency/City	Population	HD Centres	All Nurses	Certified Nurses	Machines	HD Centres	All Nurses	Certified Nurses	Machines
Bandung Barat Regency	1.846.969	2	12	9	11	1	6	5	6
Bandung City	2.461.553	18	345	251	583	7	140	102	237
Bandung Regency	3.718.660	4	90	79	120	1	24	21	32
Banjar City	206.457	2	21	20	29	10	102	97	140
Bekasi City	2.590.257	21	181	159	273	8	70	61	105
Bekasi Regency	3.214.791	10	100	79	139	3	31	25	43
Bogor City	1.063.513	10	60	55	106	9	56	52	100
Bogor Regency	5.566.838	11	115	83	170	2	21	15	31
Ciamis Regency	1.247.768	2	27	21	25	2	22	17	20
Cianjur Regency	2.542.793	1	11	10	21	0,4	4	4	8
Cimahi City	575.235	5	72	48	97	9	125	83	169
Cirebon City	341.235	4	47	36	86	12	138	105	252
Cirebon Regency	2.315.417	5	71	59	173	2	31	25	75
Depok City	2.123.349	14	100	77	154	7	47	36	73
Garut Regency	2.627.220	3	47	26	77	1	18	10	29
Indramayu Regency	1.871.832	5	44	31	85	3	24	17	45
Karawang Regency	2.505.247	14	118	102	157	6	47	41	63
Kuningan Regency	1.196.017	5	57	38	95	4	48	32	79
Majalengka Regency	1.335.460	3	37	36	62	2	28	27	46
Pangandaran Regency	432.380	0	N/A	N/A	N/A	0	N/A	N/A	N/A
Purwakarta Regency	1.028.569	5	48	37	71	5	47	36	69
Subang Regency	1.624.386	2	28	22	37	1	17	14	23
Sukabumi City	356.410	1	30	23	43	3	84	65	121
Sukabumi Regency	2.806.664	3	27	17	55	1	10	6	20
Sumedang Regency	1.167.033	3	33	32	50	3	28	27	43
Tasikmalaya City	733.467	4	88	60	113	5	120	82	154
Tasikmalaya Regency	1.906.288	1	15	12	14	1	8	6	7
West Java	49.405.808	158	1824	1422	2846	3	37	29	58
Median across regencies/cities		4	47	36	85	3	31	27	46

All-nurse density in West Java (37 pmp) is higher than the national density (34 pmp, in 2020).[7,10] Three areas with the highest density of all nurses were Bandung City (140 pmp), Cirebon City (138 pmp) and Cimahi City (125 pmp). Cianjur Regency (4 pmp), Bandung Barat Regency (6 pmp) and Tasikmalaya Regency (8 pmp) had the lowest all-nurse density.

The density of machines in West Java (58 pmp) was also higher than the national density (50 pmp, in 2020)[7,10] The highest machine densities were found in Cirebon City

(252 pmp), Bandung City (237 pmp) and Cimahi City (169 pmp). Bandung Barat Regency (6 pmp), Tasikmalaya Regency (7 pmp) and Cianjur Regency (8 pmp) had the lowest machine densities.

The number of nurses (along with machines) determines the capacity of an HD centre, reflected by incidence and prevalence. For example, Sukabumi Regency has the fourth lowest density of all nurses (10 pmp) whereas Sukabumi City, which is enclosed geographically by the former, has a relatively high all-nurses density (84 pmp) (Figure 2, bottom left; also see Table 4). At the same time, Sukabumi Regency has the second lowest incidence and fourth lowest prevalence of HD patients while Sukabumi City has the second highest incidence and sixth highest prevalence (Table 4). A portion of this surge of new patients in Sukabumi City likely came from the surrounding Sukabumi Regency in response to its shortage of nurses.

(continued)

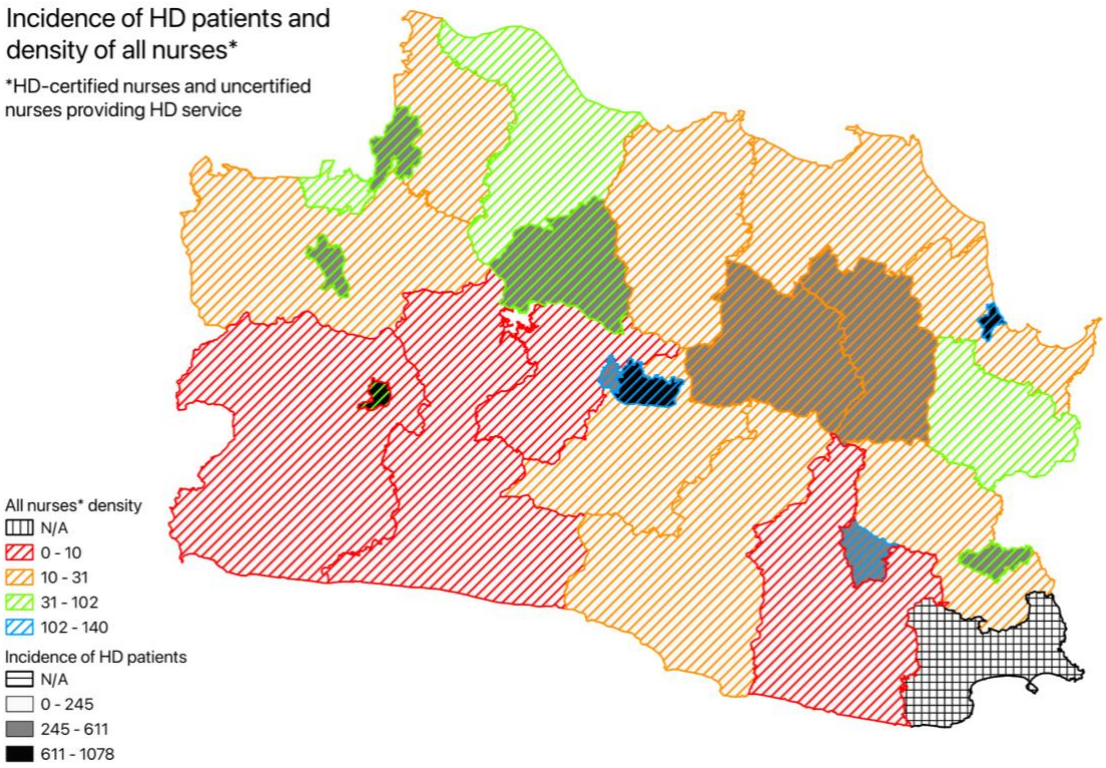
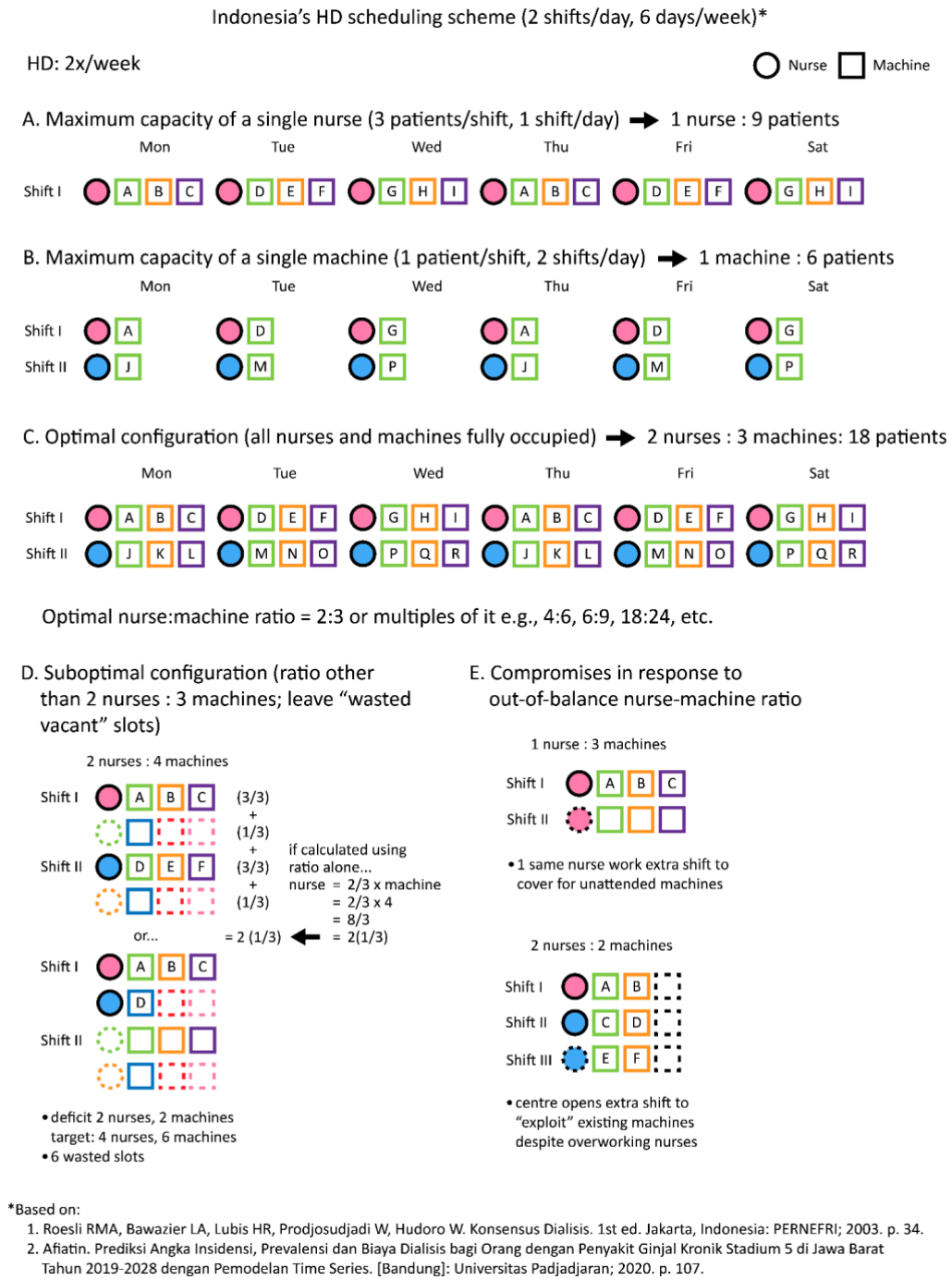


Figure 2. Map of densities of all nurses overlaid on incidences of HD patients

HD scheduling scheme in Indonesia determines the number of patients that can be served by nurses and machines (Figure 3). An HD centre in Indonesia normally operates 2 shifts daily for six working days.[9] While the thrice-weekly HD standard is recommended internationally[25], the latest national guideline (2023)[26] adjusted this to the needs and current practices in Indonesia, allowing a twice-weekly standard with its own target for adequacy parameters. That said, as mentioned in the introduction, most patients today still receive inadequate dialysis.

Yet even catching up with the twice-weekly standard is still a struggle. The fact that literally all centres (and thus regency/city aggregates) have a machine-to-active patient ratio of exactly 1:6 (not shown explicitly but calculable from Table 1 and 4) indicates that all available machines are pushed to their limits (see Figure 3B on the 1:6 maximum machine capacity). This comes at the cost of the well-being of nurses and

machines themselves: as reported elsewhere[9], many nurses have to work extra shifts (Figure 3E), while machines have no "room for trouble".



*Based on:

1. Roesli RMA, Bawazier LA, Lubis HR, Prodjosudjadi W, Hudoro W. Konsensus Dialisis. 1st ed. Jakarta, Indonesia: PERNEFRI; 2003. p. 34.
2. Afiatin. Prediksi Angka Insidensi, Prevalensi dan Biaya Dialisis bagi Orang dengan Penyakit Ginjal Kronik Stadium 5 di Jawa Barat Tahun 2019-2028 dengan Pemodelan Time Series. [Bandung]: Universitas Padjadjaran; 2020. p. 107.

Figure 3. Diagram of standard scheduling scheme for HD provision in Indonesia. Each colour represents the same nurse or the same machine.

Nurse-machine ratio other than 2:3 would either leave some nurses or machines unoccupied (Figure 3D) which, while in ideal situations could be saved as backups, would mean wasted capacity in the face of overflowing patients. This ratio does not take into account uncertified nurses who, along with supervising certified nurses, offer additional capacity. However, since uncertified nurses are expected to become certified, they may better be seen as potential numbers that would contribute to filling these shortages. Figure 3D also shows a way to calculate the "deficits" of nurses and machines while maintaining the 2:3 ratio. Ultimately, nurses and machines must continually increase at a balanced rate to catch up with the rest of the demands.

Table 5 shows the predicted numbers of all nurses and machines using the predicted number of active patients (Table 2). This may inform how many nurses and machines need to be increased, though it is important to note that this is based on the twice-weekly HD scheduling; even larger amounts are needed if we were to catch up with the ideal thrice-weekly recommendation. Only five areas had "coverage" of all nurses greater than 100%: Bandung City (145%), Cirebon City (143%), Cimahi City (130%), Tasikmalaya City (124%) and Banjar City (105%). The first four of these same areas were also the only ones with machine coverage over 100% (164%, 174%, 116% and 106%, respectively). This further illustrates the shortages of nurses and machines thus far discussed.

(continued)

Table 5. Predicted Numbers and Data Coverage of All Nurses and Machines

	N (Predicted†)		Coverage (Documented : Predicted†)	
Regency/City	All Nurses	Machines	All Nurses	Machines
Bandung Barat Regency	178	268	7%	4%
Bandung City	238	357	145%	164%
Bandung Regency	359	539	25%	22%
Banjar City	20	30	105%	97%
Bekasi City	250	375	72%	73%
Bekasi Regency	310	466	32%	30%
Bogor City	103	154	58%	69%
Bogor Regency	538	806	21%	21%
Ciamis Regency	120	181	22%	14%
Cianjur Regency	246	368	4%	6%
Cimahi City	56	83	130%	116%
Cirebon City	33	49	143%	174%
Cirebon Regency	224	335	32%	52%
Depok City	205	308	49%	50%
Garut Regency	254	381	19%	20%
Indramayu Regency	181	271	24%	31%
Karawang Regency	242	363	49%	43%
Kuningan Regency	115	173	49%	55%
Majalengka Regency	129	193	29%	32%
Pangandaran Regency	42	63	N/A	N/A
Purwakarta Regency	99	149	48%	48%
Subang Regency	157	235	18%	16%
Sukabumi City	34	52	87%	83%
Sukabumi Regency	271	406	10%	14%
Sumedang Regency	113	169	29%	30%
Tasikmalaya City	71	106	124%	106%
Tasikmalaya Regency	184	276	8%	5%
West Java	4770	7156	30%	40%
Median across regencies/cities	178	268	32%	38%

† Derived from predicted West Java prevalence by Afiatin (2020)[9] multiplied by regency/city population (Table 2), which are then divided by 9 and by 6 to attain the number of certified nurses and machines, respectively, according to the nurse-patient ratio 1:9 and machine-patient ratio 1:6 (see Figure 3)

The slow growth of certified nurses precipitates this nurse shortage. Acquiring dialysis certification is a lengthy process: nursing school graduates must work as general nurses for two years before becoming eligible to undertake four-month-long dialysis training. There is also a scarcity of available training centres: up to 2019 there were only 14 centres documented in Indonesia. The training cost was another barrier.[9] Furthermore, certification expires within three years after being issued, requiring regular recertification.

The latest information regarding this certification process can be found in the *Pedoman Pendidikan Keperawatan Berkelanjutan (PKB)* manual[27] or the CBP-INNA (Certified Body for Person–Indonesian National Nurses Association) website.[28]

4.4 Limitations and recommendations

The latest 2020 IRR report registered 180 HD centres in West Java in the database[7], thus the 158 participating centres have not fully accounted for the provision profile described in this study. While it was possible to calculate data coverage of incidence, prevalence, and densities of nurses and machines from prediction values, information on rates of CKD5 is still needed for better accuracy. This is especially important for areas with relatively low densities of HD centres and their components (or none, as in Pangandaran Regency), which might underreport actual needs. Further studies on mortality and HD dropouts are also needed (some are underway) as they may, among other things, elaborate on the discussed shortages. Other further studies such as identifying the relationship between certain administrative area characteristics (e.g., local income level or health budget) and densities of HD machines may also provide actionable insights.

4.5 Conclusion

HD provision in West Java is not yet adequate. Comparison with prediction values and other countries suggests that while HD incidence (232 pmp, 131% from predicted) in West Java is comparable to these countries, prevalence is starkly low (346 pmp, 40% from predicted), reflecting HD centres' ability to initialise but not maintain routine HD for many patients. Further studies are needed to more clearly locate these unmet needs; these include identifying CKD5 incidence and prevalence, patients on HD waiting list, and mortality rates. This inadequate provision is precipitated by the scarce number and uneven distribution of HD-certified specialists (2.1 pmp) and adult nephrologists (0.3

pmp), as well as HD nurses (37 pmp, 30% from predicted) and machines (58 pmp, 40% from predicted) in West Java, which limit the number of available HD centres and their capacities. While some are underway, more efforts by administrative authorities and the Ministry of Health are needed to increase the number of training centres and their ease of access for specialists and nurses, as well as better distribution of these workforces.

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