Supplementary Table S1. Rules for estimating annual remuneration

Item	Rule
Basic principles and data sources	Estimated annual remuneration was defined as the annualized gross, pre-tax remuneration officially reported for postgraduate clinical residents in the 2027 recruitment cycle. Information was obtained from official recruitment guidelines or official webpages of each university hospital. Third-party websites were not used as primary sources. When an official representative monthly or annual remuneration was available, that figure was preferentially used over reconstruction from individual remuneration components.
Reference year	Information applicable to residents commencing postgraduate clinical training in April 2027 was preferentially used. If cohort-specific information was unavailable, the most recent official remuneration information publicly available during the 2027 recruitment cycle was used. Prior-year actual, average, approximate, or model remuneration figures were accepted when they were presented by the institution as the current reference information and no subsequent change in remuneration was explicitly announced.
Annualization of remuneration	An officially reported representative annual remuneration was used directly. When both representative annual and monthly remuneration figures were reported for the same cohort or reference period, the annual figure was preferentially used when both represented comparable total gross remuneration. However, if one figure represented only a component of remuneration whereas the other represented total gross remuneration, the more comprehensive representative total remuneration was prioritized. An officially reported monthly remuneration was multiplied by 12. When only daily remuneration was reported, an official monthly equivalent was used when available; otherwise, the daily rate was annualized assuming 20 working days per month and 12 months per year.
First- and second-year remuneration	When remuneration differed between first- and second-year residents, the arithmetic mean of the two annualized amounts was used.
Included components	Components already incorporated into an officially reported representative monthly or annual remuneration figure were retained, including routinely expected duty, night-shift, overtime, or other allowances. When no representative total remuneration was reported, separately stated fixed allowances uniformly applicable to residents were added to the basic remuneration. When a representative total remuneration figure was available, a separately stated component was added only if it was clearly not included in that total and was uniformly payable to residents. No remuneration component was counted more than once.
Excluded components	Payments not incorporated into the officially reported representative remuneration figure and dependent on individual circumstances or actual activity, including commuting, housing, family, and other conditional allowances, were excluded. Separately stated duty, night-shift, overtime, or other activity-dependent payments were not independently added unless the institution itself incorporated them into its representative remuneration estimate. Non-remuneration benefits and reimbursements were excluded.
Bonuses	Bonuses were retained when already incorporated into an officially reported annual or model remuneration figure. When reported separately, a bonus was added only when its amount was explicitly stated or officially presented as a representative standard amount, was applicable to residents, was uniformly payable without individual eligibility requirements, and was clearly not already included in the representative remuneration figure. Bonuses with unspecified amounts, or bonuses subject to individual eligibility criteria, individual or institutional performance, or other conditional requirements, were not added.
Approximate, average, or model remuneration	An officially reported approximate, average, or model monthly or annual remuneration figure was accepted when it was presented as representative remuneration for residents. Such figures were accepted even when they incorporated routinely expected duty, overtime, or other allowances. A reported remuneration range alone was not converted to a single value, and no midpoint was imputed unless the institution itself provided a representative value.
Multiple residency programs within the same hospital	When remuneration differed across residency programs within the same university hospital, the remuneration of the program with the largest recruitment quota for the 2027 recruitment cycle was used as the representative hospital-level value. If two or more programs shared the largest recruitment quota, the remuneration of the standard or general residency program was used when explicitly identifiable. If no single representative program could be determined, the value was recorded as “Not available” rather than selected using investigator discretion.
Affiliated rotations and unavailable data	Remuneration during rotations at collaborating or affiliated hospitals was not incorporated separately or substituted for remuneration at the university hospital. The remuneration advertised for employment or training at the main university hospital was used. If neither a representative monthly or annual remuneration figure nor sufficient information to calculate annual remuneration was available, the value was recorded as “Not available” rather than estimated using additional assumptions.

Supplementary Table S2. Estimated annual remuneration for postgraduate clinical residents at university hospitals in Japan based on information available in 2026

No.	University hospital	Estimated annual remuneration (JPY)	Estimation basis
1	Hokkaido University Hospital	4,080,000	Officially reported approximate monthly remuneration of ¥340,000 × 12 months
2	Asahikawa Medical University Hospital	3,600,000	Officially reported approximate total monthly remuneration of ¥300,000 × 12 months
3	Hirosaki University Hospital	4,800,000	Officially reported approximate total monthly remuneration of ¥400,000 × 12 months
4	Tohoku University Hospital	3,378,000	(¥9,075 per day × 20 working days per month + ¥100,000 per month) × 12 months
5	Akita University Hospital	5,160,000	Officially reported approximate monthly remuneration of ¥330,000 plus a monthly incentive of ¥100,000, annualized over 12 months
6	Yamagata University Hospital	3,960,000	Officially reported approximate monthly remuneration of ¥330,000 × 12 months
7	University of Tsukuba Hospital	3,600,000	Officially reported average monthly remuneration of ¥300,000 × 12 months
8	Gunma University Hospital	3,960,000	Officially reported approximate monthly remuneration of ¥300,000 plus a monthly training allowance of ¥30,000, annualized over 12 months
9	Chiba University Hospital	2,953,200	Fixed monthly remuneration of ¥246,100 × 12 months
10	The University of Tokyo Hospital	3,105,270	Arithmetic mean of monthly remuneration of ¥253,890 in the first year and ¥263,655 in the second year, annualized over 12 months
11	Institute of Science Tokyo Hospital	3,600,000	Officially reported actual average monthly remuneration in 2025 of ¥300,000 × 12 months
12	Niigata University Medical and Dental Hospital	4,800,000	Officially reported approximate monthly remuneration of ¥400,000 × 12 months
13	University of Toyama Hospital	4,800,000	Officially reported approximate monthly remuneration of ¥400,000 × 12 months
14	Kanazawa University Hospital	5,184,000	(¥13,600 + ¥8,000) per day × 20 working days per month × 12 months
15	University of Fukui Hospital	5,031,500	¥396,000 per month × 12 months + arithmetic mean of the annual bonuses (¥224,000 and ¥335,000)
16	Shinshu University Hospital	5,100,000	Officially reported approximate annual remuneration of ¥5,100,000 for both postgraduate years
17	University of Yamanashi Hospital	3,900,000	¥290,000 per month × 12 months + arithmetic mean of the annual temporary allowances (¥360,000 and ¥480,000)
18	Gifu University Hospital	4,800,000	Officially reported approximate monthly remuneration of ¥400,000 × 12 months
19	Hamamatsu University Hospital	5,208,000	Officially reported model monthly remuneration of ¥434,000 × 12 months
20	Nagoya University Hospital	5,568,000	Officially reported actual average monthly remuneration of ¥464,000 × 12 months
21	Mie University Hospital	Not available	Only an annual remuneration range of ¥5,500,000–¥6,500,000 was officially reported; no representative value was available
22	Shiga University of Medical Science Hospital	4,128,000	Officially reported approximate annual remuneration of ¥4,128,000
23	Kyoto University Hospital	3,828,000	(¥11,450 per day × 20 working days per month + ¥90,000 per month) × 12 months
24	Osaka University Hospital	3,600,000	Officially reported approximate monthly remuneration of ¥300,000 × 12 months
25	Kobe University Hospital	3,600,000	Officially reported prior-year actual remuneration of approximately ¥300,000 per month, annualized over 12 months
26	Tottori University Hospital	4,794,000	Arithmetic mean of actual monthly remuneration of ¥391,000 in the first year and ¥408,000 in the second year, annualized over 12 months
27	Shimane University Hospital	3,906,000	Arithmetic mean of monthly remuneration of ¥310,000 in the first year and ¥341,000 in the second year, annualized over 12 months
28	Okayama University Hospital	4,452,000	Fixed monthly remuneration of ¥371,000 × 12 months
29	Hiroshima University Hospital	4,512,000	¥251,000 per month plus the arithmetic mean of the monthly training incentives of ¥110,000 and ¥140,000, annualized over 12 months
30	Yamaguchi University Hospital	5,160,000	Officially reported approximate monthly remuneration of ¥430,000 × 12 months
31	Tokushima University Hospital	5,000,000	Officially reported estimated annual remuneration of approximately ¥5,000,000 for the principal programs
32	Kagawa University Hospital	5,450,000	Arithmetic mean of estimated annual remuneration after adding the training allowance: ¥5,200,000 in the first year and ¥5,700,000 in the second year
33	Ehime University Hospital	3,480,000	Officially reported approximate monthly remuneration of ¥290,000 × 12 months
34	Kochi University Hospital	4,320,000	Arithmetic mean of approximate monthly remuneration of ¥350,000 in the first year and ¥370,000 in the second year, annualized over 12 months
35	Kyushu University Hospital	3,511,440	(¥10,131 per day × 20 working days per month + ¥90,000 per month) × 12 months
36	Saga University Hospital	4,451,640	Officially reported actual average monthly remuneration in 2025 of ¥370,970 × 12 months
37	Nagasaki University Hospital	4,680,000	Officially reported approximate monthly remuneration of ¥390,000 × 12 months
38	Oita University Hospital	4,320,000	Officially reported approximate fixed monthly remuneration of ¥360,000 × 12 months
39	Kumamoto University Hospital	3,600,000	Officially reported approximate monthly remuneration of ¥300,000 × 12 months
40	University of Miyazaki Hospital	Not available	Only an annual remuneration range of ¥4,200,000–¥5,000,000 was officially reported; no representative value was available
41	Kagoshima University Hospital	4,560,000	Officially reported approximate monthly remuneration of ¥380,000 × 12 months
42	University of the Ryukyus Hospital	4,200,000	(¥9,500 + ¥8,000) per day × 20 working days per month × 12 months
43	Sapporo Medical University Hospital	3,668,400	(¥14,285 + ¥1,000) per day × 20 working days per month × 12 months
44	Fukushima Medical University Hospital	5,272,500	Arithmetic mean of officially reported approximate annual remuneration of ¥5,031,000 in the first year and ¥5,514,000 in the second year
45	Yokohama City University Hospital	3,239,200	¥209,100 per month × 12 months + approximate annual term-end allowance of ¥730,000
46	Nagoya City University Hospital	5,211,600	Officially reported annual remuneration of ¥5,211,600
47	University Hospital, Kyoto Prefectural University of Medicine	3,840,000	Officially reported approximate monthly remuneration of ¥320,000 × 12 months
48	Osaka Metropolitan University Hospital	3,068,400	¥255,700 per month × 12 months; bonus excluded because the amount was not quantified
49	Nara Medical University Hospital	3,348,000	Fixed monthly remuneration of ¥279,000 × 12 months
50	Wakayama Medical University Hospital	3,600,000	Fixed monthly remuneration of ¥300,000 × 12 months
51	Iwate Medical University Hospital	4,610,400	Arithmetic mean of first-year [(¥300,000 + ¥50,000) × 12 months] and second-year [(¥300,000 + approximately ¥118,400) × 12 months] remuneration
52	Tohoku Medical and Pharmaceutical University Hospital	4,020,000	Arithmetic mean of monthly remuneration of ¥330,000 in the first year and ¥340,000 in the second year, annualized over 12 months
53	Jichi Medical University Hospital	5,000,000	Arithmetic mean of officially reported annual remuneration of ¥4,800,000 in the first year and ¥5,200,000 in the second year
54	Dokkyo Medical University Hospital	4,080,000	(Monthly remuneration of ¥260,000 + fixed monthly overtime allowance of ¥80,000) × 12 months
55	Saitama Medical University Hospital	4,320,000	Officially reported average monthly remuneration of ¥360,000 × 12 months
56	International University of Health and Welfare Narita Hospital	3,960,000	Arithmetic mean of monthly remuneration of ¥320,000 in the first year and ¥340,000 in the second year, annualized over 12 months
57	Nippon Medical School Hospital	3,506,400	Arithmetic mean of monthly remuneration of ¥289,700 in the first year and ¥294,700 in the second year, annualized over 12 months
58	Juntendo University Hospital	4,942,600	Arithmetic mean of model annual remuneration of ¥4,821,600 in the first year and ¥5,063,600 in the second year
59	Tokyo Medical University Hospital	2,880,000	Officially reported approximate monthly remuneration of ¥240,000 × 12 months
60	Tokyo Women's Medical University Hospital	3,261,000	Arithmetic mean of monthly remuneration of ¥269,500 in the first year and ¥274,000 in the second year, annualized over 12 months
61	Keio University Hospital	4,300,000	Officially reported approximate annual remuneration of ¥4,300,000, including duty fees
62	Showa Medical University Hospital	3,840,000	Officially reported model monthly remuneration of approximately ¥320,000 × 12 months
63	The Jikei University Hospital	3,840,000	Officially reported illustrative monthly remuneration of approximately ¥320,000 × 12 months
64	Toho University Medical Center Omori Hospital	3,000,000	Fixed monthly remuneration of ¥250,000 × 12 months
65	Teikyo University Hospital	2,880,000	Fixed monthly remuneration of ¥240,000 × 12 months
66	Nihon University Itabashi Hospital	4,440,000	Officially reported average monthly remuneration of approximately ¥370,000, including allowances, annualized over 12 months
67	Kyorin University Hospital	3,600,000	Arithmetic mean of model annual remuneration of ¥3,500,000 in the first year and ¥3,700,000 in the second year
68	Kitasato University Hospital	3,734,200	Arithmetic mean of first-year [(¥261,400 + ¥41,800) × 12 months + ¥30,000] and second-year [(¥269,400 + ¥43,100) × 12 months + ¥50,000] remuneration
69	Tokai University Hospital	4,008,000	Arithmetic mean of monthly remuneration of ¥332,000 in the first year and ¥336,000 in the second year, annualized over 12 months
70	St. Marianna University School of Medicine Hospital	3,600,000	Officially reported expected monthly remuneration of approximately ¥300,000 × 12 months
71	Kanazawa Medical University Hospital	4,440,000	Officially reported approximate monthly remuneration of ¥370,000, including allowances, annualized over 12 months
72	Aichi Medical University Hospital	6,000,000	Arithmetic mean of model annual remuneration of approximately ¥5,700,000 in the first year and ¥6,300,000 in the second year
73	Fujita Health University Hospital	5,594,400	Officially reported model monthly remuneration of ¥466,200, assuming four emergency room overtime sessions per month, annualized over 12 months
74	Osaka Medical and Pharmaceutical University Hospital	3,600,000	Fixed monthly remuneration consisting of a base remuneration of ¥250,000 and a training allowance of ¥50,000, annualized over 12 months
75	Kansai Medical University Hospital	4,620,000	Officially reported model annual remuneration of approximately ¥4,620,000
76	Kindai University Hospital	4,419,000	Arithmetic mean of model monthly remuneration of ¥365,500 in the first year and ¥371,000 in the second year, annualized over 12 months
77	Hyogo Medical University Hospital	4,307,604	Officially reported actual average monthly remuneration in 2024 of ¥358,967 × 12 months
78	Kawasaki Medical School Hospital	4,100,000	Officially reported approximate annual remuneration of ¥4,100,000, including night-work allowance
79	Kurume University Hospital	4,080,000	Arithmetic mean of officially reported annual remuneration of ¥3,960,000 in the first year and ¥4,200,000 in the second year
80	Fukuoka University Hospital	3,660,000	Arithmetic mean of approximate monthly remuneration of ¥300,000 in the first year and ¥310,000 in the second year, annualized over 12 months
81	Hospital of the University of Occupational and Environmental Health	3,300,000	Fixed monthly remuneration of ¥275,000 × 12 months
82	National Defense Medical College Hospital	Excluded	Excluded from the analytic sample according to the prespecified university-hospital eligibility criteria

Notes:All amounts represent estimated gross, pre-tax annual remuneration in Japanese yen (JPY) for postgraduate clinical training undertaken at the university hospital. Estimates were based on the latest official remuneration information available in 2026. When the latest available information consisted of prior-year actual remuneration, that amount was used. When remuneration differed between the first and second postgraduate years, the arithmetic mean of the two annualized amounts was calculated. When an official representative, model, or average monthly or annual remuneration was reported, that amount was used as the primary basis for estimation. Separately reported remuneration components forming part of standard compensation were added when applicable. For daily-rate remuneration, 20 working days per month was assumed for standardization. Variable or conditional allowances were not added separately unless they were explicitly included in an officially reported representative, model, or average amount. When only a remuneration range was reported and no representative value could be determined, the value was recorded as "Not available." Remuneration at collaborating or affiliated hospitals was not substituted for remuneration at the university hospital. National Defense Medical College Hospital was retained in the table for completeness but excluded from the analytic sample according to the prespecified eligibility criteria.

Supplementary Table 3. Historical analysis of the 2025 residency matching cycle

Variable	Model 1 (n = 81)	Model 2 (n = 81)	Model 3 (n = 79)
Habitable-area population density, per doubling	1.93 (1.59–2.35), P<0.001	1.73 (1.39–2.16), P<0.001	1.67 (1.32–2.11), P<0.001
Hospital beds, per 100 beds	—	1.12 (0.94–1.34), P=0.206	1.11 (0.93–1.34), P=0.250
University ownership			
National	—	Reference	Reference
Public	—	1.15 (0.47–2.82), P=0.753	1.12 (0.45–2.79), P=0.809
Private	—	2.35 (1.12–4.93), P=0.024	2.51 (1.18–5.35), P=0.017
Estimated annual remuneration, per 1 million JPY	—	—	0.74 (0.47–1.14), P=0.171

Values are odds ratios (95% confidence intervals).
Model 1 included log-transformed habitable-area population density only. Model 2 additionally included hospital bed count and university ownership. Model 3 additionally included estimated annual resident remuneration. Habitable-area population density is presented as the OR corresponding to a doubling of density. Hospital bed count was scaled per 100 beds, and annual remuneration per 1 million JPY. The outcome was modeled as grouped matched and unfilled residency positions using quasi-binomial logistic regression. ORs greater than 1 indicate higher odds that an available residency position was filled. Estimated annual remuneration was unavailable for two hospitals; therefore, Model 3 included 79 hospitals.

Supplementary Table S4. Sensitivity analyses for the association between habitable-area population density and residency position filling in 2026

Analysis	Model 2 OR per doubling (95% CI)	P value	Model 3 OR per doubling (95% CI)	P value
Prespecified quasi-binomial model	1.56 (1.24–1.95)	<0.001	1.54 (1.21–1.96)	<0.001
Equal-hospital-weight analysis	1.55 (1.23–1.96)	<0.001	1.55 (1.21–1.99)	<0.001
Conventional binomial regression	1.56 (1.45–1.67)	<0.001	1.54 (1.43–1.66)	<0.001
Beta-binomial regression	1.60 (1.31–1.95)	<0.001	1.60 (1.30–1.98)	<0.001
Geographic-unit clustered robust standard errors	1.56 (1.29–1.89)	<0.001	1.54 (1.27–1.86)	<0.001
Complete-case analysis*	1.58 (1.26–1.98)	<0.001	—	—
Leave-one-hospital-out analysis†	1.47–1.73	<0.01 in all analyses	—	—

* Model 2 was restricted to the 79 hospitals with available remuneration data, corresponding to the analytic sample used in Model 3.

† Values represent the range of ORs obtained by sequentially excluding each of the 81 hospitals. The corresponding P values ranged from <0.001 to 0.002.

Values are odds ratios (ORs) and 95% confidence intervals (CIs) per doubling of habitable-area population density. Model 2 adjusted for hospital bed count and university ownership. Model 3 additionally adjusted for estimated annual resident remuneration.

Supplementary Table S5. Model diagnostics for the 2026 quasi-binomial regression analyses

Diagnostic	Model 1	Model 2	Model 3
Number of hospitals	81	81	79
Dispersion parameter	13.45	10.44	10.48
Adjusted GVIF, GVIF^(1/[2×df])			
Log habitable-area population density		1.2	1.26
Hospital beds		1.3	1.31
University ownership		1.06	1.07
Estimated annual remuneration		—	1.13
Assessment of nonlinearity for population density*			
F statistic	—	1.58	—
Degrees of freedom	—	2, 74	—
P value	—	0.213	—
Influence diagnostics for Model 2†			
Maximum Cook's distance	—	0.776	—
DFBETA for log population density at the observation with maximum Cook's distance	—	−0.918	—
Maximum leverage	—	0.247	—

* The prespecified linear Model 2 was compared with a model incorporating a natural spline with 3 degrees of freedom for log-transformed habitable-area population density. † Influence diagnostics were calculated for the prespecified primary adjusted Model 2. Leave-one-hospital-out results are presented in Supplementary Table S4. GVIF, generalized variance inflation factor.