Population-based study on coverage and healthcare processes for cancer during implementation of national healthcare insurance in Indonesia

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Summary

Background A national healthcare insurance has been implemented in Indonesia since 2014. Although cancer care currently represents a smaller part of the healthcare support, the demographic development will lead to a rapid growth of the population within age groups at cancer risk. This requires strategic and developmental planning of cancer care resources. Based on data of the national healthcare insurance, current cancer care processes and their determinants were evaluated.

Methods Nationwide reimbursement data as well as demographic, economic and healthcare infrastructure data were used for the study. Poor and underserved population was stratified according to the national classification system. Availability of healthcare resources was evaluated at provincial level. Cancer care usage was analysed applying descriptive and multivariate statistical approaches (regression, cluster analysis, tree classification).

Findings Cancer care was provided in primary care (PHC) for 2.6/1000 and advanced care (AHC) for 4.8/1000 participants within the family-based membership structure. Regression analysis revealed human resource availability in rural/remote areas a determinant for cancer PHC. Cancer care in AHC was determined by PHC provided by general practitioners (GP), availability of AHC infrastructure (Class A & B hospital beds) and treatment migration between provinces. Tree classification confirmed predominant roles of GP, AHC infrastructure and referral between cancer care provider levels.

Interpretation Cancer care will gain much higher importance for the Indonesian healthcare system within the next decade. Infrastructure, human resources, and process development should avoid rising overload of cancer care delivery by targeting reduction of treatment migration (availability of GPs in rural/remote provinces), improvement of referral systems (effective clinical selection processes and back-referral) and AHC cancer care structures (regional distribution of Class A & B hospitals).

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Keywords: Healthcare delivery; Referral; Poor population; Primary care; Remote population; Availability; Accessibility; Acceptability; Universal health coverage; Cancer care

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Research in context

Evidence before this study

A systematic and nationwide analysis of cancer care processes in Indonesia under the framework of the novel national healthcare insurance has not been done yet. Expected high increase of cancer cases in the near future would require early and data-based planning of cancer care human resources and infrastructure. Investigations of single cancer entities and specific cancer care processes suggested limitations in the cancer care delivery chain.

Added value of this study

This investigation identified distribution of general practitioners (GPs) and nursing staff in primary cancer care and availability of class A&B hospital beds for advanced cancer care as key determinants of related delivery processes. In addition, high migration of cancer patients for care between provinces was found and pointed to ineffective referral processes.

Implications of all the available evidence

Development of cancer care infrastructure, human resources for healthcare (HRH) and processes should focus on avoidance of the increasing overload. Reduction of treatment migration (availability of GPs in rural/remote provinces), improvement of referral systems (effective clinical selection processes and back-referral) and AHC cancer care structures (regional distribution of Class A&B hospitals) are recommended as development strategy accompanied by formalized regular monitoring and evaluation.

Introduction

Universal Health Coverage (UHC) concept was adopted for national healthcare policy in many low-income and middle-income countries (LMIC).[1,2] An example is the wide disparity in cancer care in LMIC's which is mainly determined by a gap of socio-economic conditions, insufficient awareness, and difficulties to access the facilities for cancer care especially in countries with large geographical extent and many remote/rural regions.[3] A very ambitious example is Indonesia's national health scheme (JKN) targeting the entire population of 255 million by end of 2019.[4]

This implementation is accompanied by Indonesia's new challenges that are emerging with a population with rapidly increasing numbers of older individuals during the next decade and subsequent changes in the expected morbidity spectrum. Currently, almost 70% of the disease burden is due to non-communicable diseases including cancer and this will grow as Indonesia completes its epidemiological transition.[5] Furthermore, the country's geographical and socioeconomic population structure provide additional tasks to achieve sufficient healthcare coverage for the entire population. Although differences between healthcare delivery for poor and near-poor people (nationally referred as PBI population) still need to be solved the success of healthcare provision for these insurance members is already remarkable.[6] Eligibility for PBI membership status is related to a national definition based on income, family status and region of residence. Healthcare development related to cancer burden requires strategic decisions and continuous monitoring.[7–9] Equitable healthcare in cancer concerns primarily towards reducing the geographical disparity regarding healthcare facilities, human resources, and economic ability, especially for most poor people living in remote/rural areas. For example, in 2015 the poor living in rural areas counted for ~63% of all poor people in Indonesia with substantial inequalities in healthcare utilization.[10] However, data-based evaluations of cancer care delivery and its influencing factors has not been provided yet for the entire country and the novel healthcare insurance. In the recent years some investigations were published about cancer burden and care in Indonesia, but they mainly focused on single entities, outcome or prevention topics, such as vaccination.[11–13] Although JKN increased the number and equitable distribution of healthcare facilities in remote/rural areas during the first implementation period the distribution of poor population was expected as critical point for provision of cancer care and, therefore, specifically targeted in this study.[2,3]

Healthcare infrastructure in Indonesia for primary care (PHC) is mainly based on Puskesmas/Pratama clinics (Indonesian type of outpatient facilities) and primary care hospitals (class D), whereas advanced care (AHC) is mostly provided in level C/B (secondary/tertiary) hospitals and at the national level (class A hospitals).

Recently, we reported that the availability of human resources for healthcare (HRH) is critical for PHC usage especially for the remote/rural population. Guiding referral and utilization of primary care were identified as key success factors for effective and efficient usage of available healthcare infrastructure and UHC achievement in Indonesia.[7] This investigation based on the entire JKN dataset focused on cancer care delivery processes under PHC and AHC conditions and included potential infrastructural and HRH factors to identify determinants of cancer care implementation. The aim of the current study was to identify key determinants that are relevant in guiding cancer care and to conclude on a cancer care development strategy for Indonesia.

Methods

Study design

Data acquisition. Information about demographics, economic data and healthcare infrastructure were used from public resources of the Indonesia Central Statistic

Agency.[14] All insurance related data (year 2018) were obtained by BPJS (Social Insurance Administration Organization) national head office. As previously described,[7] these data represented a random selection from a family membership based JKN registration and corrected as individual sampling weight for further statistical calculations. For selection of cancer care final diagnoses within reimbursement requests were applied and limited to ICD10-codes C00-D48. Datasets on projection of Indonesia's population from 1980 to 2020 were used for prediction of cancer care requirements.[15] Ethical approval was provided by the Muhammaniyah University (No. 202/EC-KEPK FKIK UMY/Vlll/2020) and BPJS (No. 5060/I.2/0419). Informed consent was not applicable.

Definition of poor population and underserved regions. According to the membership structure of the BPJS participants were stratified by income:

- PBI memberships: poor people supported by government due to low income
- Non-PBI memberships: members not supported regarding insurance fees

For annotation of rural/remote regions the national classification system was used at the provincial level, located in 27 of 34 provinces. Recently, we published three different clusters of the Indonesian provinces and a factorial analysis that discriminated human and infrastructural resources for Indonesian PHC (Figure 1 Suppl).[7] Characteristics of these clustering approaches were listed in Table 1. More details on methodology are provided as supplementary material.

Analytical strategy

Descriptive approach. For each province cancer care usage data were extracted based on the above-mentioned indexes (PHC- and AHC Population Coverage Rates).

The extent of treatment migration into and from the provinces was evaluated using migration related indexes. If appropriate Student's *t*-tests were used for comparison of overall and cancer care.

Cancer care service in PHC and AHC was described within the different clustering options and compared by χ^2-tests. Canonical correlation analysis addressed distribution of variances of target parameters.

Multivariate analysis. For multivariate analysis included many variables. Collinearity was assumed for variables with $R>0.8$ in cross-correlations. In these cases, only one variable was used for further analysis. ANOVA method was applied for univariate group comparison. Scheffé method and Bonferroni correction were done for multivariate analyses and related post-hoc tests. Discriminance analysis was used for cluster characteristics describing PHC and AHC cancer care delivery in a stepwise approach. Univariate ANOVA, Wilks-Lambda and Eigenwert provided information about quality of discrimination functions.

For multiple linear regression all related variables in each test approach were evaluated using the stepwise backward method as first step to reduce the number of potential regressors. Cross correlation pointed to potential multi-collinearity and the respective variables were excluded. Using PHC and AHC Population Coverage Rate as dependent descriptors of cancer care, obtained sets of variables were subsequently included into a hierarchical regression to confirm their importance as regressors. Homoscedasticity and standardized residuals were tested for resulting regression models. The significance of obtained regression models was tested by *F*-test. R^2 determined overall predictive power represented by explained variance. Standardized regression Beta-coefficients were used to identify significant regressor variables.

Tree classifications

For confirmation of determinants for cancer care coverage and to enable conclusions for differentiated healthcare delivery development, obtained regressors were included into a tree classification. As build-up method the Chi² automatic interaction detection (CHAID) was used (max. number of levels n=3; minimum size of knots n=3 provinces; splitting accepted for $p<0.005$).

All statistical analyses were performed using IBM SPSS Statistics Version 26. For map presentations the Geonames Microsoft TomTom tool was used.

Role of funding source

BPJS Kesehatan provided the data for the current study. The funders had no role in the design, data collection, analysis, and interpretation, or preparation of this manuscript.

Ethics approval

Ethical approval was obtained from the Muhammadiyah University (No. 202/EC-KEPK FKIK UMY/Vlll/2020) and the Indonesian National Healthcare Insurance BPJS (No. 5060/I.2/0419) for the entire project. All methods were performed in accordance with Declaration of Helsinki.

Results

Cancer care description

Analysis of PHC and AHC cancer care showed differences between provider structures and various insurance membership groups. Out of the 1,733,759 data lines for PHC capitation (unweighted raw data) ICD-selection and weighing revealed 135,082,175 overall treatments and 689,638 families receiving cancer care in PHC

A) Cluster of provinces	Puskesmas per district	HRH per puskesmas	Covered population per puskesmas	Covered population per physician	Covered population per nurse/midwife	Hospital beds per 1.000 population
high population coverage	1,30	80,3	13887,6	3270,5	331,7	1,30
high resources	2,03	196,4	28785,1	2669,9	381,0	1,37
low resources	1,56	130,1	44494,2	4216,9	802,9	0,99

B) Cluster of provinces	% rural in total population	% urban poor in total population	% rural poor in total population	% total poor in total population
Remote High Poor	67,28%	8,02%	18,16%	14,65%
Non-Remote	22,39%	5,39%	8,35%	6,24%
Remote Low Poor	51,17%	6,48%	9,74%	8,10%

C) Infrastructure cluster	Demographic cluster Remote High Poor	Non-Remote	Remote Low Poor	Total
High Population Coverage	13	7	0	20
High Resources	1	6	3	10
Low Resources	0	3	1	4
Total	14	16	4	34

***Table 1*: Characterization of provinces clusters: A) Average availability of healthcare infrastructure in different province clusters; B) Distribution of poor and rural/remote population in demographic province clusters; C) Comparison of province clusters based on demographic and healthcare infrastructure variables; distribution of numbers of provinces differed significantly (*p*=0.007).**

capitation setting. From 104,456 PHC non-capitation data 7,606,831 family services were received. However, non-capitation based PHC cancer care was recorded in only 5367 cases and, therefore, neglected in further analysis. Data for AHC were obtained from 906,915 raw data lines (77.8 mio overall AHC treatments, evaluable 96.6%). For cancer care 1,270,354 AHC reimbursement records were available.

For the entire country 509.7 PHC and 293.8 AHC treatments per 1,000 population were performed, whereas cancer care was less frequently (PHC: 2.6/1000; AHC: 4.8/1000). Within the PHC service spectrum cancer related diagnoses only represented ~0.5% of the capitation cases (Figure 1).

PHC cancer care was provided by general practitioners (GPs) (16.9%), Puskesmas (50.1%) and Pratama clinics (33.0%). GP delivery was highly correlated with no referral to further treatment (R=0.67; p<0.001), but not to overall PHC (R=0.135) and AHC (R=−0.127) cancer treatment. Similarly, correlations of HRH parameters for rural/remote regions with PHC or AHC cancer care coverage were not observed (data not shown).

Overall referral for treatment to non-residential provinces occurred in 4.6% with differences between provinces that was more extended for cancer care (7.9%). Significant differences were observed between migration from and migration to provinces both for overall and cancer care (p=0.047). Its majority was found between DKI Jakarta and surrounding provinces (61.1% of all migrations) as well as DI Yogyakarta/adjacent provinces (14.1%), respectively (Figure 2).

Analysis of population cancer care coverage. Discrimination of demographic clusters was found when PHC and AHC coverage and treatment migration data were included, and two discrimination functions were obtained (Table Suppl 2). Resulting discrimination functions were characterized as “High and Low Cancer Care Coverage” and significantly differentiated the province clusters (Figure 3A). By looking at the healthcare infrastructure the “High population coverage” cluster was also clearly distinct, mainly attributed to PHC coverage & treatment migration. AHC coverage discriminated to a certain extent the provinces belonging to the “High and Low resource” clusters (Figure 3B). Provinces with extended rural/remote and poor population were predominated by low cancer care coverage and high treatment migration. Surprisingly, provinces with urban and non-poor population had low cancer care migration, but also limited cancer care coverage per population compared to provinces with rural/remote and low poor population structures.

Discrimination functions describing PHC coverage & treatment migration and AHC coverage were obtained for HRH clusters (Figure 3C) revealing that

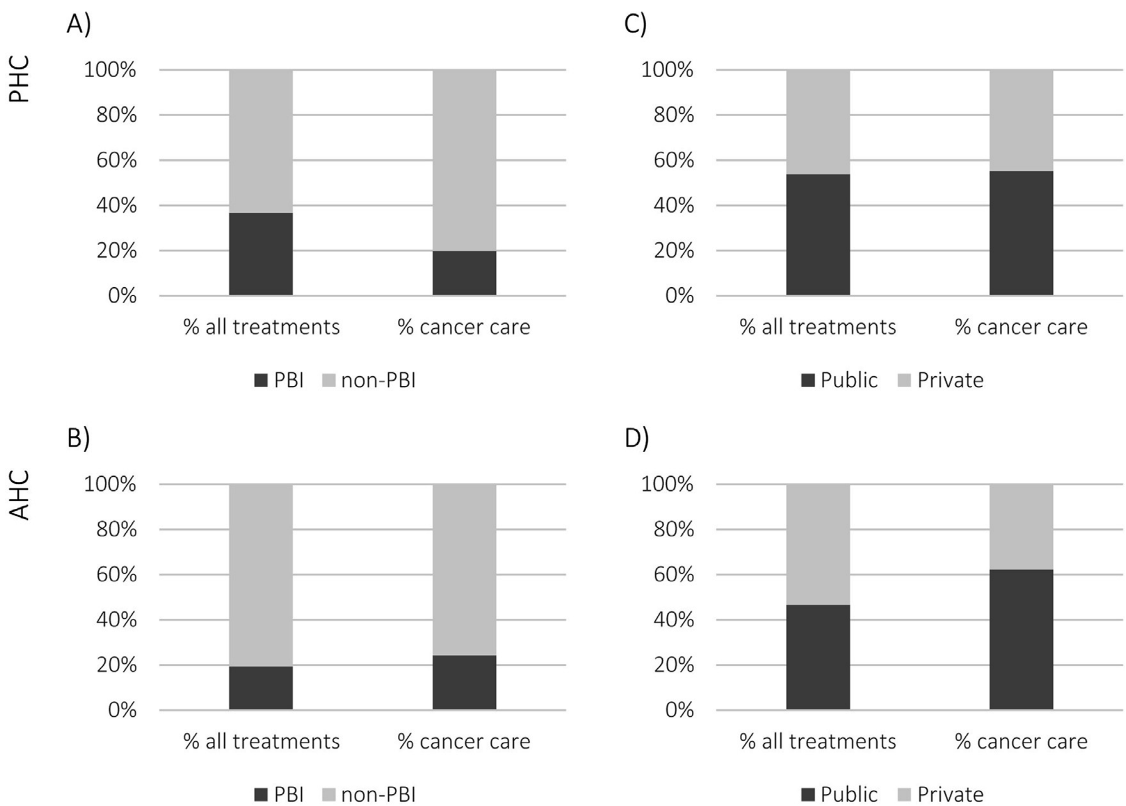

Figure 1. Provision of cancer care for PBI- and Non-PBI members PHC, AHC; and according to provider ownership. A) PHC was less taken from PBI members compared to overall healthcare service (19.9% vs. 36.7%). B) In AHC this percentage was higher (1.6%), but still only a minor part of the entire treatment activities and significantly different between PBI (2.0%) and Non-PBI (1.5%) members (p=0.002). C) These treatments in PHC were provided almost equally distributed between public and private entities (55.3% vs. 44.7%) and almost exclusively handled on an outpatient basis (99.2%) with frequent referral to AHC (74.6%). D) In contrast to PHC public providers were more frequently involved in AHC cancer care than private entities (62.4% vs. 37.6%). Overall AHC services were managed in 79.5% as outpatient and 20.5% as inpatient treatment, whereas in cancer care inpatient services were more important (Inpatient: 51.3% vs. Outpatient: 48.3%).

provinces with low HRH only provided limited PHC resulting in higher treatment migration to other provinces. Provinces where the available healthcare infrastructure covered large population fractions enabled more PHC cancer care compared to other provinces.

Regression analysis resulted in predicting variables that can explain variances for cancer care coverage between provinces. Included variables were differentiated between cancer care delivery process and healthcare infrastructure/HRH descriptors. Resulting regression function ($p<0.001$) showed five contributing regressors (% PHC cancer PBI; % cancer PHC GP; AHC cancer treatment migration from province per 1000; % AHC cancer inpatient; % AHC cancer referral to hospital) and explained 73.6% variance (R^2). If the proportion of PBI members (Beta: 4.621; $p<0.001$) and provision of cancer care by GP (Beta: 0.317; $p<0.011$) in a province was higher, PHC cancer care coverage was significantly increased. Inversely, this resulted in a negative dependence from referral behaviour towards hospitals for AHC (Beta: -1.359; p=0.027). These findings were in line with a correlation between PHC cancer care provided by GP and non-referral to AHC (R=0.67, $p<0.001$) that was similarly found in the regression analysis with a high relative importance for prediction of PHC coverage (Beta = −1.375; p=0.008). GP-driven PHC had also positive effects regarding subsequent AHC with higher referral to hospital care (Beta: 1.087; p=0.010) on an inpatient basis ($p<0.001$). (Table Suppl 3A)

For PHC resource analysis revealed two significant regressors (HR in remote regions per 100.000 rural population [Nurse + Midwife] (p=0.021); HR in remote regions per 100.000 rural population [Total of HRH] (p=0.044)). Trends were seen for Standardized Density of Physicians per Population [p=0.097] and Standardized Average Population per Puskesmas [p=0.068]). The obtained regression function (p=0.001) described R^2=77.4% of variance. Overall high availability of HRH led to the highest predictive impact on PHC cancer care coverage (Beta: 8.735; p=0.044). In contrast, if HRH

Figure 2. Treatment migration A) from and B) to provinces (only relevant for provinces in Java) for AHC cancer care. Within ACH 25.7% of cancer care services were handled as inter-hospital referral between the different service levels whereas 68.4% were referred to outpatient service. The majority (57.8%) of these inter-hospital transfers occurred as direct up-referral to the highest service level (class A hospitals and special oncology centres) and 17.8% to class B hospitals. Back-referral was found only in 2.8% of the referrals between hospitals.

availability was predominated by nursing staff low PHC coverage was predictable (Beta: 7.135; p=0.021). (Table Suppl 3B)

For AHC three regressors (p<0.001) were identified (% cancer PHC GP; PHC cancer population coverage per 1000; AHC cancer treatment migration to province per 1000) with similar variance explanations (R^2=74.0%). Suitably, the extent of AHC for cancer was negatively determined by PHC provision by GPs, but with small impact (Beta: 8.735; p=0.044). Interestingly, a positive, highly significant prediction of PHC cancer care coverage was observed for extent of AHC delivery (Beta: 0.621; p<0.001). Not surprisingly, the extent of cancer care migration towards a province strongly influenced AHC provision in recipient provinces (Beta: 1.087; p=0.010). (Table Suppl 3C) Finally, infrastructure determinants predicted AHC cancer care by two regressors (Number of class A hospital beds per 1000 population; Standardized Density of Physicians per Population) (p<0.001; R^2=65.7%). The availability of class A hospitals determined the extent of AHC delivery (Beta: 0.546; p=0.002) and was inversely related to the overall availability of physicians (Beta: −0.297; p=0.049). (Table Suppl 3D)

Since regression analyses suggested an important role of GP and nursing availability regarding treatment migration from the provinces additional canonical correlation analyses underlined the relevance of HRH availability in rural/remote regions as potential determinants of treatment migration for cancer care (data not shown). Migration to and from provinces significantly discriminated the clusters and almost completely

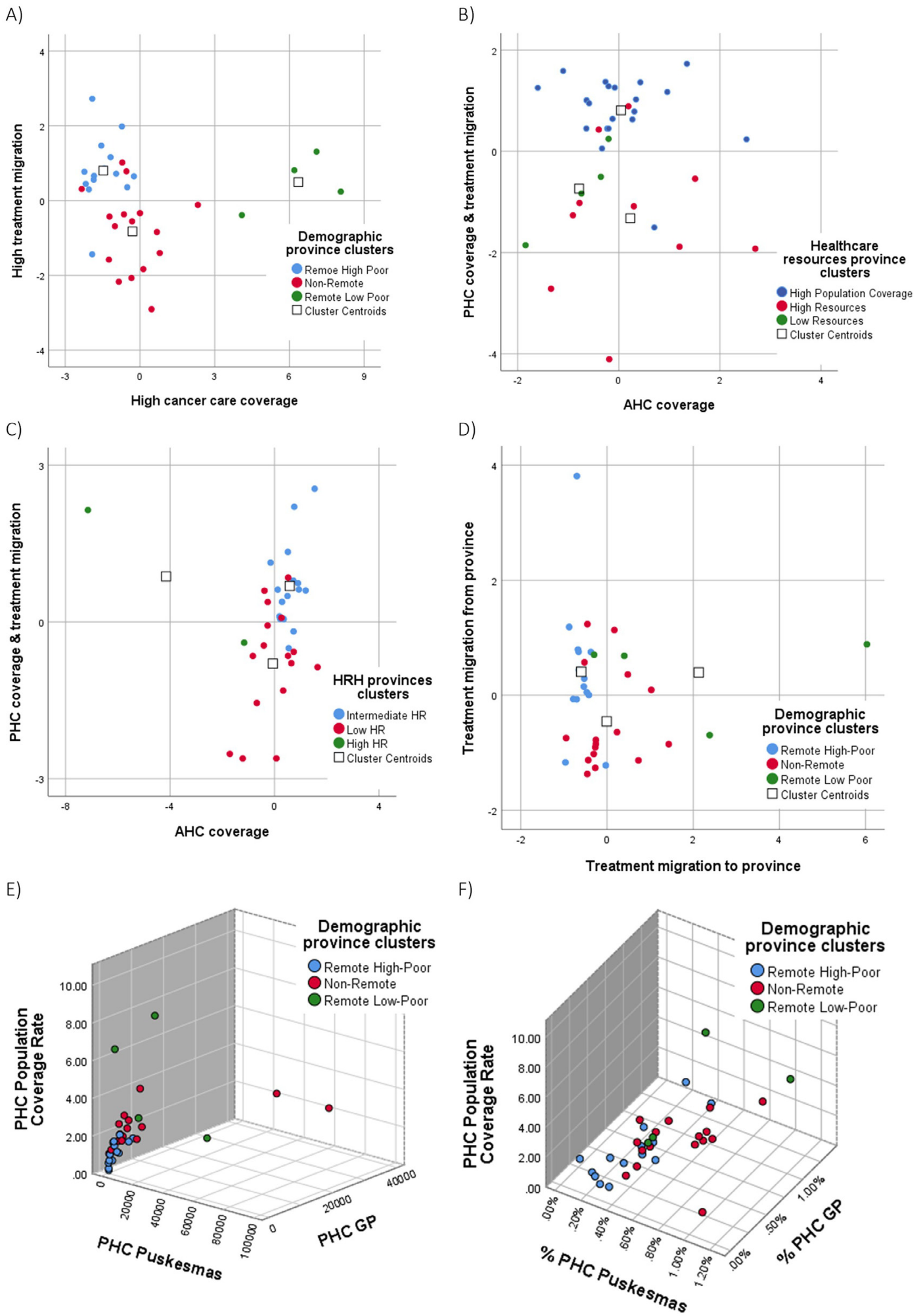

Figure 3. Discriminance functions and PHC provider importance for province clusters.

Figure 4. Classification trees for main determinants of A) PHC and B) AHC cancer care population coverage rates. Diagrams within the boxes represent histograms of provinces numbers on a 10-scale of the respective coverage rates.

explained the observed variance. Treatment migration occurred mainly from the Remote High-Poor cluster provinces and at low frequency from the Non-Remote province cluster. (Figure 3D) In addition, the importance of provider availability for PHC cancer care was further supported by significant correlations between PHC Population Coverage Rates and the delivery structure. Remote High-Poor provinces with low delivery by Puskesmas/Pratama clinics (R=0.592; p<0.001) and GP (R=0.368; p=0.032) had low coverage rates which was clearly different in demographic province clusters (Figure 3E). In contrast, no referral from PHC to AHC correlated more intensively with GP delivery (R=0.670; p<0.001) than with delivery by Puskesmas/Pratama clinics (R=0.494; p=0.003). If the relative impact of cancer care within the overall healthcare coverage was considered the role of GPs was less distinct between Remote High-Poor provinces and Non-Remote provinces whereas the role of Puskesmas/Pratama clinics related care remained predictive for PHC coverage. (Figure 3F).

Tree classifications. In a tree analysis, the demographic province clusters were applied as independent variable for key determinants of PHC cancer care within these provinces. High PCH cancer population coverage rates in the Remote Low-Poor cluster were confirmed and identified regressors did not further differentiate these provinces (5.1±2.8 cases per 1.000 population; p<0.001). The Non-Remote province cluster was characterized by intermediate PHC cancer population coverage rates (2.3±1.0). Within this cluster the available nursing staff was the key determinant for cancer care provision. If overall healthcare was predominated by nursing the overall cancer care was significantly (p=0.010) lower (1.5±0.4) than in provinces with lower involvement of nursing staff (3.0±0.9). In Remote High-Poor provinces (1.1±0.6) the provision of cancer care by GP predicted higher PCH cancer population coverage rates (0.8±0.5 vs. 1.5±0.4; p<0.039) (Figure 4A).

The most important factor that differentiated AHC were available class A hospital beds per population within the provinces (450±194; p<0.001). In provinces with high availability the second AHC infrastructure (class B hospitals) further differentiated within this group (334±167 vs. 537±181; p=0.025). Within the intermediate class A group (276±69) the extent of treatment migration for AHC towards the provinces was a negative coverage predictor (237±39 vs. 354±38; p<0.001). Finally, within the lowest class A group (184±52) overall availability of physicians per population discriminated the AHC cancer coverage rates (151±30 vs. 227±41; p<0.001) (Figure 4B).

Discussion

During the implementation of the national health insurance system, discrepancies in the regional roll-out were expected similarly to other countries potentially resulting in negative impact on clinical outcome.[15–17] In our investigation, large regional differences for cancer care were observed for Indonesia. Only ~8% of the population is currently at age above 65 years and, therefore, within the typical cancer incidence group. If the current age group 50-65 years is considered, additional approximately 20% of the population will come into this vulnerable population group within the next decade creating an intensive challenge for cancer care development (Figure 6 Suppl). A similar increase in incident cancer cases was predicted for Asia from 6.1 million in 2008 to 10.7 million in 2030 and cancer deaths from 4.1 million in 2008 to 7.5 million in 2030. These projections mostly take into account demographic changes in the population,[18] and changing lifestyles, among other cancer risk factors.[19]

The national roll-out policy for cancer focuses on class A&B hospitals under AHC type reimbursements. It is, therefore, not surprising that the percentage of AHC cancer care in overall healthcare is more than three time higher than for PHC.

Inequity of HRH and its high predictive impact on PHC cancer care seems to be a kind of contradictive. The stepwise analytical approach showed that primarily the overall availability of cancer care resources is important for the respective coverage in the provinces. At the second level, HRH subgroups become important. GP availability was a positive determinant of PHC and negative regressor for AHC cancer coverage. In contrast, predominance of HRH availability by nursing staff was a negative predictor. GPs' involvement reduced referral to AHC, but not in rural/remote regions where GP availability was very low. However, throughout the country GPs provided only ~15% of primary cancer care Puskesmas (~60% supported by physicians) covered >50% of these services. If GPs were available, they would have provided basic PHC cancer care and referral required would have been less compared to provinces with low GP availability. Missing correlation to AHC can be explained by the very limited role of GP for this sector and the independent frequency of cancer care from this availability. If PHC is dominated by nursing staff due to lack of available physicians esp. in remote regions, the extent of primary cancer care is highly limited and referral to AHC and treatment migration occur more frequently. Overall, PHC as first cancer care access point was functioning if resources were available. However, this was a clear limitation in Remote High-Poor provinces predominated by low healthcare resources.

GP-driven PHC was more intensively related to PBI members and the non-poor population obviously circumvented PHC directly accessed AHC for cancer treatment. AHC cancer care was almost exclusively provided by class A and to a smaller extent by class B hospitals as direct access or up-referral from lower-level healthcare providers and its availability predicted advanced cancer care coverage. Limited AHC hospital beds in the Remote High-Poor provinces resulted in a high treatment migration between provinces for cancer representing ~8% of overall cancer care in Indonesia. Enormous differences were observed between the provinces and in some provinces (mainly Remote High-Poor cluster) more than one third of the cancer patients were treated outside. In contrast, only two provinces were main receivers of these migrations (Jakarta and Yogyakarta). Although some neighboring effects of provinces may partially explain this migration a large impact is related to the lack of available qualified structures especially in provinces belonging to the Remote High-Poor cluster. Relevant proportion of this care does not require highly specialized structures enabling down-referrals and proper selection of cancer cases for specialized AHC for more effective resources usage and reduction of treatment migration. However, treatment migration is also determined by patients' acceptance of resources and quality of care. In addition, accessibility is also determined by distances (rural/remote areas), financial burden of travel, and other socioeconomic factors that likely are more present in PBI members, but this was not investigated in this study.

In Remote High-Poor provinces GPs inclusion of into cancer care seems to be essential. Within the intermediate group (Non-Remote cluster) the observed effects suggest that the predominance of nursing staff within the HRH resources likely replaced the involvement of physicians in cancer care with subsequent reduced PHC cancer care coverage rates. Reasons for the higher GP involvement might be higher qualification to perform basic cancer care and an interest to maintain patients locally (Suppl. Figure 7).

The special situation of GP in primary cancer care and related referral processes have been similarly reported for European rural regions, such as in Denmark,[20] the Netherlands,[21] among others.[22] Comparable data for other LMICs have not been published yet. For LMICs cultural and societal differences have been identified as major implementation barriers for cancer care that likely have similar impact in Indonesia. Examples are recognition of cancer symptoms, educational level, knowledge about cancer, anxiety and fear for cancer, role of alternative medicine and illness presentation, acceptance belief in traditional medicine and religious practices for treatment, lack of social and financial support, language and communication, and stigmatization, among others.[23,24] Our results suggest focusing on better selection in PHC for AHC referral and improved diagnostic opportunities as basis for selection[25] with a central role of GPs for improvement and long-term cancer care development in Indonesian rural regions.[26] This fits to the challenges for this country that are already known in other fields of healthcare provision.[27–29]

The current analysis focused on general provision of cancer care and referral but did not investigate dedicated healthcare procedures, such as prevention or similar cancer-related topics, comorbidities, age structure and patient-related barriers, which would enable to evaluate quality of care. Reimbursement control systems were established that include regular data check and provider audits. The huge extent of the insured population and data protection regulation required randomisation and weighted data selection. Although a data selection bias cannot be completely ruled out the authors consider this limitation as not relevant for the major conclusions.

Limitations are related to the reimbursement character of the available data that are not dedicated towards process evaluation. In the initial implementation phase the enrolment into the BPJS showed some differences between the provinces and various population groups.[7] However, at the time related to data analysis this rate was >70% throughout the country suggesting sufficient background for the general conclusions. The low percentage of cancer care provided by GP may interfere with some statistical approaches. In our analysis we assumed linearity and reduced the number of variables for regression analysis with the risk to oversee interactions of the determinants. However, the initially large number of variables and comparison at the provincial level may result in an even higher modelling uncertainty if nonlinear approaches would have been used. We belief that assumption of linearity is sufficient for describing the major cancer care delivery processes.

In summary, cancer care will gain much higher importance for the Indonesian healthcare system within the next decade. Infrastructure, HRH, and process development should focus on avoidance of increasing overload of cancer care. This seems to be achievable by targeting reduction of treatment migration (availability of GPs in rural/remote provinces), improvement of referral systems (effective clinical selection processes and back-referral) and AHC cancer care structures (regional distribution of Class A&B hospitals). This should be accompanied by formalized regular monitoring and evaluation of national service plans.[30] Very likely, major findings can be transferred to other countries with similar healthcare and demographic structures.

Contributors

JS: concept, data analysis, writing, results interpretation; SW: concept, writing, discussion; AA: data provision, data quality; SP: discussion; AG: data provision, data interpretation; JH: concept, data analysis, writing.

Data sharing statement

The datasets generated and/or analysed during the current study are not publicly available due to data protection rules of the BPJS national health insurance but are available from the corresponding author (A.A.) on reasonable request.

Editor note

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Declaration of interests

AA, AGM, and SS are employees of the BPJS health insurance; JH: projects from Ministry of Research and Education (Germany) and Ministry of International Collaboration (Germany), received funding for attending meeting from Indonesian Embassy (Germany), CEO at IGP-Institute for Public Health and Healthcare; JS: Chair Scientific Advisory Board at IGP-Institute for Public Health and Healthcare Science.

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Supplementary materials

Supplementary material associated with this article can be found in the online version at doi:10.1016/j.lansea.2022.100045.

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