Every preventable cancer averted. Every screenable cancer detected.
Every cancer patient counted.

2023 CARE PH
Annual Report

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CEO'S CORNER

It is November 2024 as I write this, nearly 18 months after the COVID pandemic was declared over on May 5, 2023. By then it had infected over 700 million and claimed the lives of nearly 7 million people. (https://news.un.org/en/story/2023/05/1136367)

In the four years since the first lockdown in the Philippines in March 2020, CARE PH has struggled to continue its mission of having *"every preventable cancer averted, every screenable cancer detected, and every cancer patient counted".* Thanks to the 27 hospitals who continued to maintain and share their de-identified hospital cancer registry data, we were able to keep track of the cancer census in member hospitals and publish annual reports based on our central database in 2020, 2021, and 2022.

2023 CARE PH Registry

In 2023, the sharing of data continued, but by then some CARE PH hospitals which were also DOH hospitals encoded their cancer data directly into the DOH iHOMIS, while other CARE PH hospitals stopped encoding completely due to their hospital's shift to electronic medical records and upgrade of their hospital information systems. This is the reason for the slightly delayed publication of this 2023 CARE PH Annual Report.

In the meantime, in 2023, CARE PH finished up its research projects which were carried out in collaboration with specialty oncology society groups and academic institutions. Specifically, site-specific cancer registries (blood malignancies, urologic malignancies, and hepatocellular cancer) were put to bed, hopefully temporarily, as the gathered data were summarized, analyzed and submitted to peer reviewed journals for possible publication. The 6-year (2017-2022) data in the Central CARE PH database was also cleaned and analyzed in 2023 and the article *"Challenges in the Maintenance of an Open Hospital-Based Cancer Registry System in a LMIC"* (https://doi.org/10.1371/journal.pdig.0000328) was published January 2024.

By December 2023, the CARE PH Board of Trustees realized that with its current "business model", the registry arm of the organization was not sustainable. At the same time, we were hopeful that with the NICCA's mandate requiring all hospitals to submit their hospital cancer registry data to Philippine Cancer Center, CARE PH's registry arm would either be 1) rendered obsolete, or 2) be funded by the DOH through a Public-Private Partnership Agreement. We continue to be in a holding pattern regarding which of these two options will come to fruition.

In the meantime, the Philippine Cancer Center, which was undergoing birthing pains during the pandemic, and which needed to align with the data architecture of the National Health Data Repository of Philhealth, consolidated input from all hospital cancer registry stakeholders and in a consensus meeting held on October 2024, has come up with a single harmonized hospital cancer registry data collection form to be adopted by all hospital cancer registries in the country, including CARE PH HBCR. Once the PCC-HBCR is up and running, the CARE PH app will be updated by including all the data fields in the harmonized cancer data collection form.

CARE PH hospitals, which used to share their data into a centralized CARE PH database, will no longer do so and will send their data directly to PCC-HBCR. As before, each hospital can still access their own data and analyze this in order to come up with quality improvement and innovative projects for better healthcare of their hospital's cancer patients. *"Better healthcare for the Filipino cancer patient"* continues to be the vision of CARE PH.

2023 CARE PH Research

The CANDLE Study Team recruited its last patient in Jan 2023. As far as we know, this was the first research study funded by the PCHRD which included Artificial Intelligence and machine learning methods in the analysis of its data. The beginnings of a hepatocellular carcinoma (site-specific) registry was one of its main outputs, together with a Liver Disease registry whose database we are sharing with the Liver Study Group of the UP College of Medicine.

CARE PH actively participated in the 2023 Philippine Datathon Organizing Ways and Means Committee and is continuing to advocate for data science education and application in Health AI research as we move together *"Towards Better Healthcare for the Filipino Cancer Patient."*

As CARE PH enters 2025, we will be focusing more on helping specialty groups or individual researchers create and expand well curated site-specific cancer registries, and/or access the already existing registries so they can interrogate and mine the data and find answers to their research questions.

CARE PH will also work with individual hospitals or groups of hospitals who wish to use the updated CARE PH HBCR app containing the PCC/DOH/PHIC/PCS/CARE PH harmonized HBCR data collection form for their hospital cancer registry, in fulfillment of the DOH requirement that all hospitals must have a hospital cancer registry and submit their cancer registry data to the DOH through the Philippine Cancer Center.

Sincerely yours,

Trixie Tiangco
CEO and Co-Founder
CARE PH

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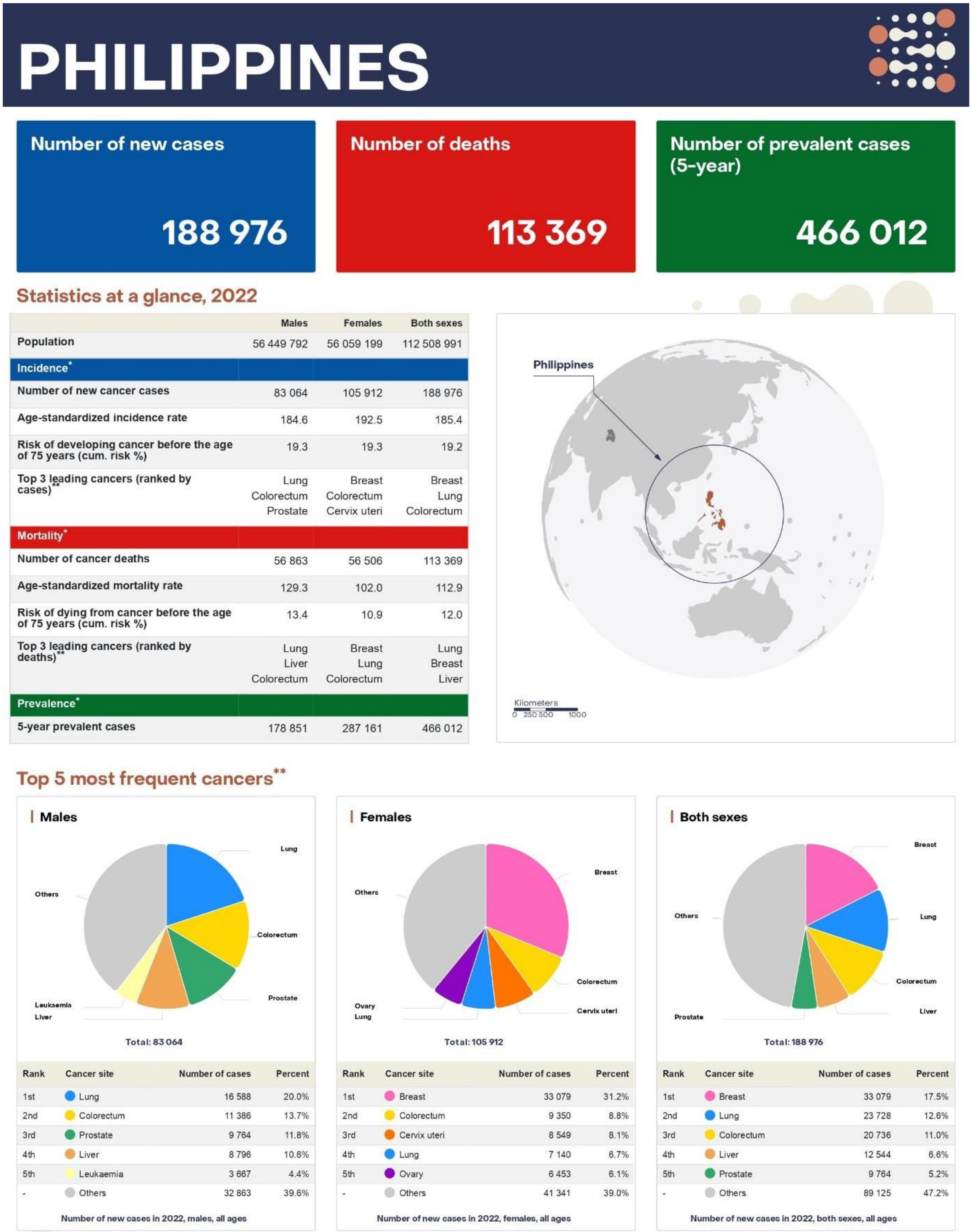
CANCER BURDEN IN THE PHILIPPINES

GLOBOCAN 2022

The CANCER TODAY website provides a comprehensive assessment of the worldwide cancer burden, through the GLOBOCAN estimates of incidence, mortality and prevalence for 36 cancer types for a particular year. The latest data available is from 2022. The Philippine data is sourced from the Manila Cancer Registry and Rizal Cancer Registry weighted/simple average of the most recent local rates, applied to the 2022 population of 112,508,991 Filipinos. According to the report, the estimated number of new cases of cancer for 2022 was 188,976, or a 23% percent increase from the 2020 new cases of 153,751; the number of cancer deaths for the same period showed a similar twenty-two percent increase to 113,369 from 92,606 in 2020.

The top ten incident cancers in the Philippines, based on the 2022 GLOBOCAN data presented in Figure 1 are: Breast Cancer, Lung Cancer, Colorectal Cancer, Liver Cancer, Prostate Cancer, Cervical Cancer, Thyroid Cancer, Leukemia, Ovarian Cancer, and Uterine Cancer.

The top ten most common cause of cancer deaths in the Philippines, based on the 2022 GLOBOCAN data presented in Figure 1 are: Lung Cancer, Breast Cancer, Liver Cancer, Colorectal Cancer, Leukemia, Cervical Cancer, Ovarian Cancer, Pancreatic Cancer, Prostate Cancer, and Stomach Cancer.



PHILIPPINES

Number of new cases
188 976

Number of deaths
113 369

Number of prevalent cases (5-year)
466 012

Statistics at a glance, 2022

	Males	Females	Both sexes
Population	56 449 792	56 059 199	112 508 991
Incidence*			
Number of new cancer cases	83 064	105 912	188 976
Age-standardized incidence rate	184.6	192.5	185.4
Risk of developing cancer before the age of 75 years (cum. risk %)	19.3	19.3	19.2
Top 3 leading cancers (ranked by cases)**	Lung Colorectum Prostate	Breast Colorectum Cervix uteri	Breast Lung Colorectum
Mortality*			
Number of cancer deaths	56 863	56 506	113 369
Age-standardized mortality rate	129.3	102.0	112.9
Risk of dying from cancer before the age of 75 years (cum. risk %)	13.4	10.9	12.0
Top 3 leading cancers (ranked by deaths)**	Lung Liver Colorectum	Breast Lung Colorectum	Lung Breast Liver
Prevalence*			
5-year prevalent cases	178 851	287 161	466 012

Top 5 most frequent cancers**

Males

Total: 83 064

Rank	Cancer site	Number of cases	Percent
1st	● Lung	16 588	20.0%
2nd	● Colorectum	11 386	13.7%
3rd	● Prostate	9 764	11.8%
4th	● Liver	8 796	10.6%
5th	● Leukaemia	3 667	4.4%
-	● Others	32 863	39.6%

Number of new cases in 2022, males, all ages

Females

Total: 105 912

Rank	Cancer site	Number of cases	Percent
1st	● Breast	33 079	31.2%
2nd	● Colorectum	9 350	8.8%
3rd	● Cervix uteri	8 549	8.1%
4th	● Lung	7 140	6.7%
5th	● Ovary	6 453	6.1%
-	● Others	41 341	39.0%

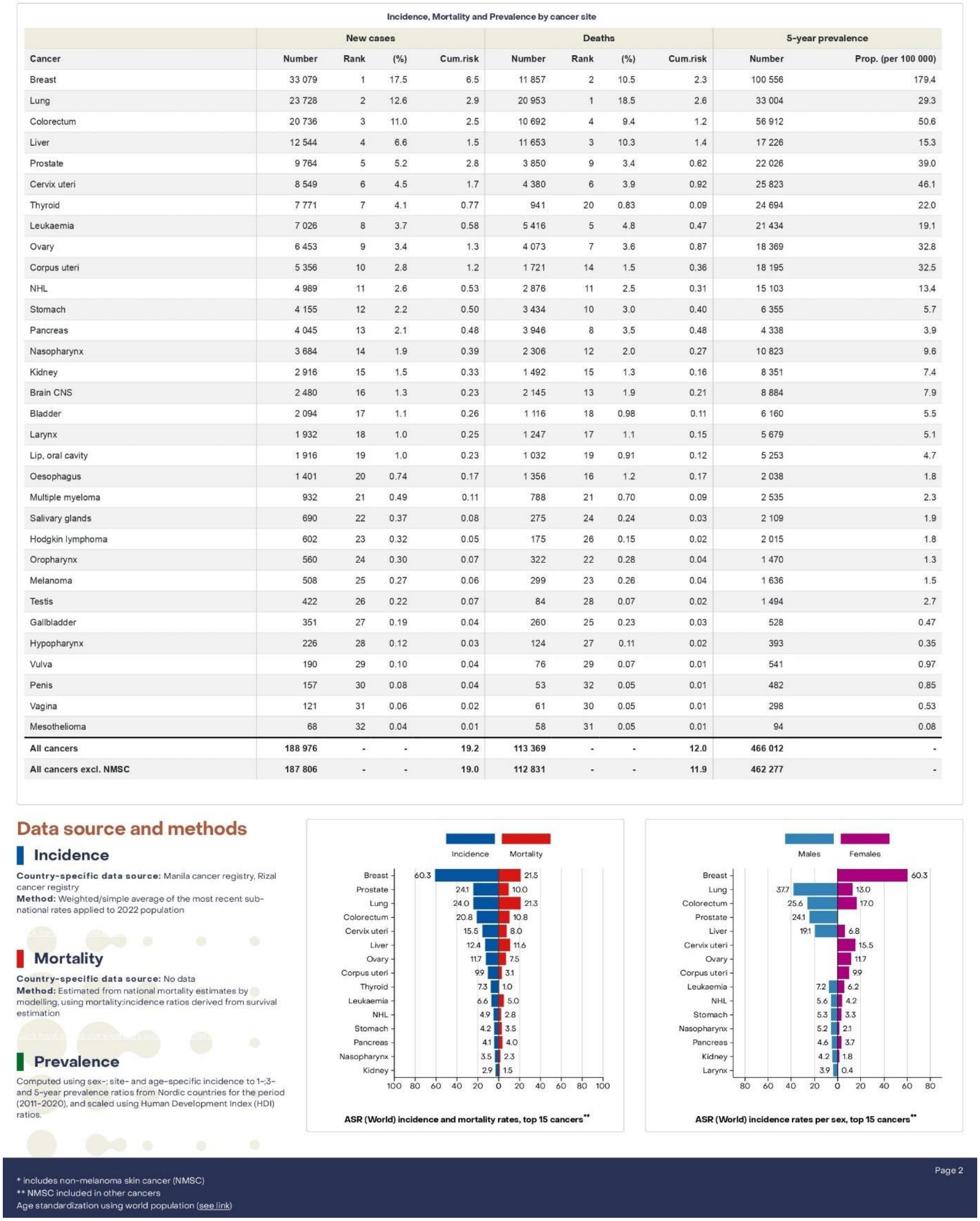
Number of new cases in 2022, females, all ages

Both sexes

Total: 188 976

Rank	Cancer site	Number of cases	Percent
1st	● Breast	33 079	17.5%
2nd	● Lung	23 728	12.6%
3rd	● Colorectum	20 736	11.0%
4th	● Liver	12 544	6.6%
5th	● Prostate	9 764	5.2%
-	● Others	89 125	47.2%

Number of new cases in 2022, both sexes, all ages



Incidence, Mortality and Prevalence by cancer site

	New cases				Deaths				5-year prevalence	
Cancer	**Number**	**Rank**	**(%)**	**Cum.risk**	**Number**	**Rank**	**(%)**	**Cum.risk**	**Number**	**Prop. (per 100 000)**
Breast	33 079	1	17.5	6.5	11 857	2	10.5	2.3	100 556	179.4
Lung	23 728	2	12.6	2.9	20 953	1	18.5	2.6	33 004	29.3
Colorectum	20 736	3	11.0	2.5	10 692	4	9.4	1.2	56 912	50.6
Liver	12 544	4	6.6	1.5	11 653	3	10.3	1.4	17 226	15.3
Prostate	9 764	5	5.2	2.8	3 850	9	3.4	0.62	22 026	39.0
Cervix uteri	8 549	6	4.5	1.7	4 380	6	3.9	0.92	25 823	46.1
Thyroid	7 771	7	4.1	0.77	941	20	0.83	0.09	24 694	22.0
Leukaemia	7 026	8	3.7	0.58	5 416	5	4.8	0.47	21 434	19.1
Ovary	6 453	9	3.4	1.3	4 073	7	3.6	0.87	18 369	32.8
Corpus uteri	5 356	10	2.8	1.2	1 721	14	1.5	0.36	18 195	32.5
NHL	4 989	11	2.6	0.53	2 876	11	2.5	0.31	15 103	13.4
Stomach	4 155	12	2.2	0.50	3 434	10	3.0	0.40	6 355	5.7
Pancreas	4 045	13	2.1	0.48	3 946	8	3.5	0.48	4 338	3.9
Nasopharynx	3 684	14	1.9	0.39	2 306	12	2.0	0.27	10 823	9.6
Kidney	2 916	15	1.5	0.33	1 492	15	1.3	0.16	8 351	7.4
Brain CNS	2 480	16	1.3	0.23	2 145	13	1.9	0.21	8 884	7.9
Bladder	2 094	17	1.1	0.26	1 116	18	0.98	0.11	6 160	5.5
Larynx	1 932	18	1.0	0.25	1 247	17	1.1	0.15	5 679	5.1
Lip, oral cavity	1 916	19	1.0	0.23	1 032	19	0.91	0.12	5 253	4.7
Oesophagus	1 401	20	0.74	0.17	1 356	16	1.2	0.17	2 038	1.8
Multiple myeloma	932	21	0.49	0.11	788	21	0.70	0.09	2 535	2.3
Salivary glands	690	22	0.37	0.08	275	24	0.24	0.03	2 109	1.9
Hodgkin lymphoma	602	23	0.32	0.05	175	26	0.15	0.02	2 015	1.8
Oropharynx	560	24	0.30	0.07	322	22	0.28	0.04	1 470	1.3
Melanoma	508	25	0.27	0.06	299	23	0.26	0.04	1 636	1.5
Testis	422	26	0.22	0.07	84	28	0.07	0.02	1 494	2.7
Gallbladder	351	27	0.19	0.04	260	25	0.23	0.03	528	0.47
Hypopharynx	226	28	0.12	0.03	124	27	0.11	0.02	393	0.35
Vulva	190	29	0.10	0.04	76	29	0.07	0.01	541	0.97
Penis	157	30	0.08	0.04	53	32	0.05	0.01	482	0.85
Vagina	121	31	0.06	0.02	61	30	0.05	0.01	298	0.53
Mesothelioma	68	32	0.04	0.01	58	31	0.05	0.01	94	0.08
All cancers	**188 976**	-	-	**19.2**	**113 369**	-	-	**12.0**	**466 012**	-
All cancers excl. NMSC	**187 806**	-	-	**19.0**	**112 831**	-	-	**11.9**	**462 277**	-

Data source and methods

Incidence

Country-specific data source: Manila cancer registry, Rizal cancer registry
Method: Weighted/simple average of the most recent sub-national rates applied to 2022 population

Mortality

Country-specific data source: No data
Method: Estimated from national mortality estimates by modelling, using mortality:incidence ratios derived from survival estimation

Prevalence

Computed using sex-; site- and age-specific incidence to 1-;3- and 5-year prevalence ratios from Nordic countries for the period (2011-2020), and scaled using Human Development Index (HDI) ratios.

ASR (World) incidence and mortality rates, top 15 cancers**

ASR (World) incidence rates per sex, top 15 cancers**

* includes non-melanoma skin cancer (NMSC)
** NMSC included in other cancers
Age standardization using world population (see link)

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Figure 1. GLOBOCAN 2022 estimates of incidence and mortality in the Philippines

CARE PH HOSPITAL-BASED CANCER REGISTRY

2023 Consolidated Cancer Census

Twenty-seven (27) member hospitals have completed sharing their data as of November 2024, for a total of 21,816 new registrants in 2023. This represents a 31% increase in the number of new registrants (from N = 16,708 registrants in 2022 to 21,816 registrants in 2023) from the same number of contributing hospitals in 2022.

A breakdown of the primary cancer sites is shown in Figure 2.

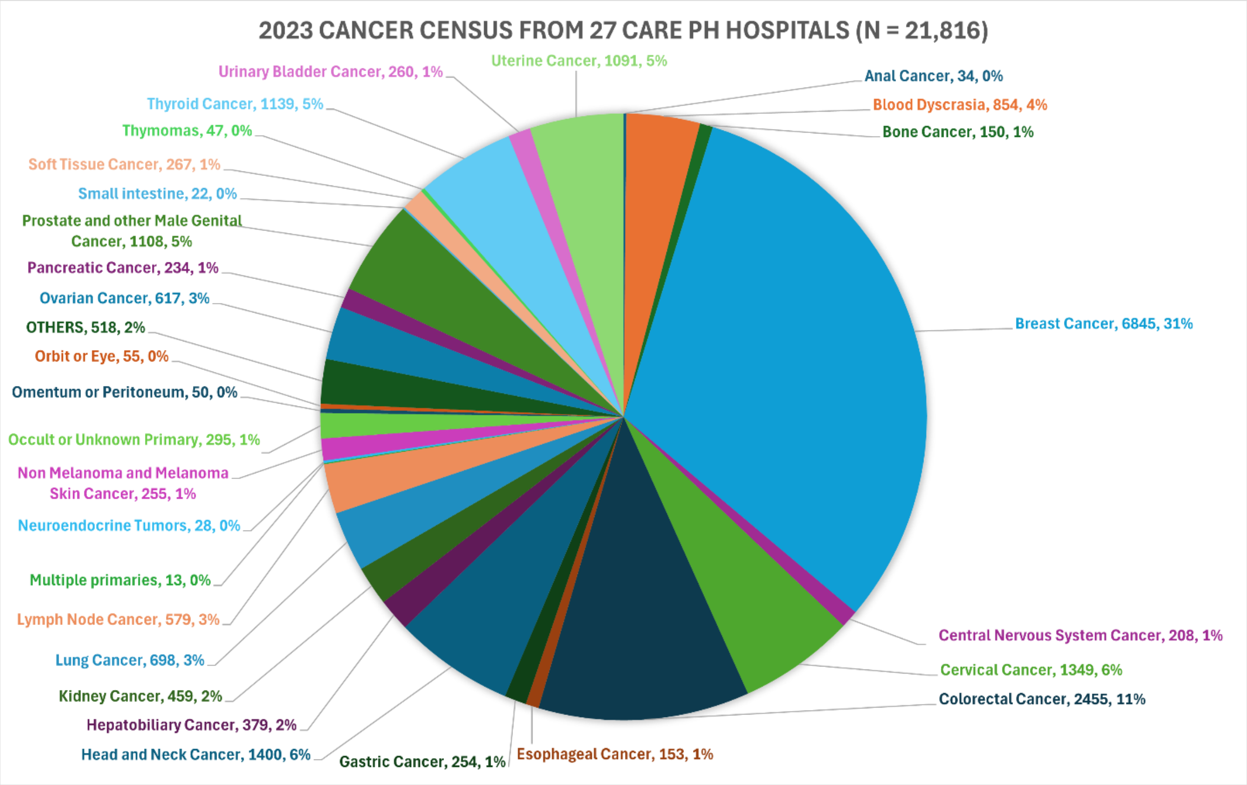


Figure 2. Frequency of primary cancer sites in CARE PH cancer census 2023

The top ten most frequently diagnosed cancers in the CARE PH Registry System are: Breast Cancer, Colorectal Cancer, Head and Neck Cancer, Cervical Cancer, Thyroid Cancer, Prostate Cancer, Uterine Cancer, Blood Dyscrasia, Lung Cancer, and Ovarian Cancer.

Table 1. CARE PH monthly summary per institution in 2023

No.	Institution	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1	Baguio Medical Center	0	0	3	1	0	3	2	7	2	2	2	0	22
2	Batangas Medical Center	73	63	65	44	61	50	60	56	97	54	46	61	730
3	Bicol Medical Center	113	104	108	74	113	85	87	98	89	98	92	69	1130
4	Bulacan Sacred Heart	0	0	1	0	0	0	0	0	0	0	0	0	1
5	Calamba Medical Center	2	0	0	0	0	0	0	0	0	0	0	0	2
6	Cardinal Santos Medical Center	67	79	76	61	87	58	69	69	47	50	43	34	740
7	Chinese General Hospital	170	207	179	155	155	176	183	177	200	188	189	138	2117
8	Dagupan Doctors Villaflor Memorial Hospital	125	131	170	165	194	198	146	117	116	130	124	90	1706
9	Davao Doctors Hospital	4	3	2	2	4	7	1	8	8	13	15	47	114
10	Dr. Jose N. Rodriguez Memorial Hospital and Sanitarium	4	10	11	5	4	6	8	7	4	4	8	4	75
11	East Avenue Medical Center	68	185	73	89	103	103	520	100	307	180	137	167	2032
12	General Santos Doctors Hospital	7	7	9	5	2	5	6	1	1	1	3	5	52
13	Global Cancer Care Institute	12	14	3	1	5	2	6	2	1	1	1	2	50
14	Iloilo Doctors Hospital	30	38	28	31	34	29	25	38	33	35	32	19	372
15	Makati Medical Center	106	100	132	105	114	111	141	124	113	102	96	99	1343
16	Medical Center Manila	18	24	31	13	20	33	21	16	19	22	22	22	261
17	National Kidney & Transplant Institute	147	168	147	121	204	98	162	133	137	27	141	128	1613
18	Northern Mindanao Medical Center	91	100	124	169	178	132	95	99	85	70	67	57	1267
19	Palawan MMG-PPC	1	1	2	4	1	5	5	7	6	4	3	0	39
20	Philippine General Hospital	419	421	485	404	480	447	438	433	404	413	374	372	5090
21	Rizal Medical Center	55	53	64	38	55	54	47	46	48	72	43	41	616
22	The Medical City	109	138	144	128	113	171	86	105	127	153	121	121	1516
23	The Medical City Clark	12	13	4	4	11	1	7	4	15	7	0	0	78
24	The Medical City Pangasinan	6	0	0	0	0	0	0	0	0	0	0	0	6
25	TMC Iloilo	4	9	4	5	7	3	6	4	4	4	4	5	59
26	Western Visayas Medical Center	0	0	20	140	185	168	105	12	47	28	0	0	705
27	Zamboanga Del Sur Medical Center	20	2	8	5	5	2	1	8	4	11	14	0	80
		1663	1870	1893	1769	2135	1947	2227	1671	1914	1669	1577	1481	21816

2023 CARE PH Member Hospitals

Only 27 (68%) of a total 40 CARE PH hospital members were able to share, and 13 (32%) were unable to share any 2023 data. The reasons given for non-sharing were: 1) Continued focus on recovery from the pandemic, or change in hospital management during pandemic, 2) Preference to give hospital cancer data directly to DOH, 3) Lack of human resource to encode data, and 4) Lack of computer server or hospital local area network.

Table 2. 2023 CARE PH Hospital Name, Level, Type, and Bed Capacity

Hospital Name	Level	Type	Bed Capacity
NCR (N=10)			
1. AMOSUP-Seamen’s Hospital – Manila	Tertiary	Private	100
2. Cardinal Santos Medical Center	Tertiary	Private	245
3. Chinese General Hospital	Tertiary	Private	600
4. Dr. Jose N. Rodriguez Memorial Hospital and Sanitarium	Tertiary	Government	2,000
5. East Avenue Medical Center	Tertiary	Government	600
6. Makati Medical Center	Tertiary	Private	600
7. Medical Center Manila	Tertiary	Private	200
8. National Kidney and Transplant Institute	Tertiary	Specialty Government	500
9. Philippine General Hospital	Tertiary	Government	1,500
10. The Medical City – Pasig	Tertiary	Private	800
LUZON (N=18)			
1. Baguio Medical Center	Primary	Government	500
2. Batangas Medical Center	Tertiary	Government	500
3. Bicol Medical Center	Tertiary	Government	500
4. Bicol Regional Training and Teaching Hospital	Tertiary	Government	600
5. Calamba Medical Center	Tertiary	Private	122
6. Dagupan Doctors Villaflor Memorial Hospital	Tertiary	Private	125
7. De La Salle University Medical Center	Tertiary	Private	300
8. Global Care Cancer Institute	n/a	Standalone	n/a
9. Mary Mediatrix Medical Center	Tertiary	Private	174
10. Naga Imaging Center Cooperative Doctors Hospital	Tertiary	Private	99
11. Palawan MMG Cooperative Hospital	Tertiary	Private	80
12. Rizal Medical Center	Tertiary	Government	500
13. Sacred Heart Hospital of Malolos	Secondary	Private	99
14. Southern Isabela Medical Center	Tertiary	Government	350
15. St. Paul Hospital – Tuguegarao	Tertiary	Private	250
16. The Medical City – Clark	Tertiary	Private	100
17. The Medical City – Pangasinan	Tertiary	Private	70

18. The Medical City – South Luzon	Tertiary	Private	150
VISAYAS (N=3)			
1. Iloilo Doctors' Hospital	Tertiary	Private	300
2. The Medical City – Iloilo	Tertiary	Private	108
3. Western Visayas Medical Center	Tertiary	Government	400
MINDANAO (N=9)			
1. Ciudad Medical de Zamboanga	Tertiary	Private	160
2. Cotabato Regional Medical Center	Tertiary	Government	600
3. Davao Doctors Hospital	Secondary	Private	250
4. General Santos Doctors Hospital	Tertiary	Private	202
5. Metro Davao Medical Research Center	Secondary	Private	129
6. Northern Mindanao Medical Center	Tertiary	Government	400
7. Southern Philippines Medical Center	Tertiary	Government	1,200
8. Zamboanga City Medical Center	Tertiary	Government	250
9. Zamboanga Del Sur Medical Center	Secondary	Government	250
TOTAL (N=40)			
#Red font = No data shared in 2023			

The following hospitals have the highest contribution to the total number of new registrants for CARE PH in 2023:

PHILIPPINE GENERAL HOSPITAL

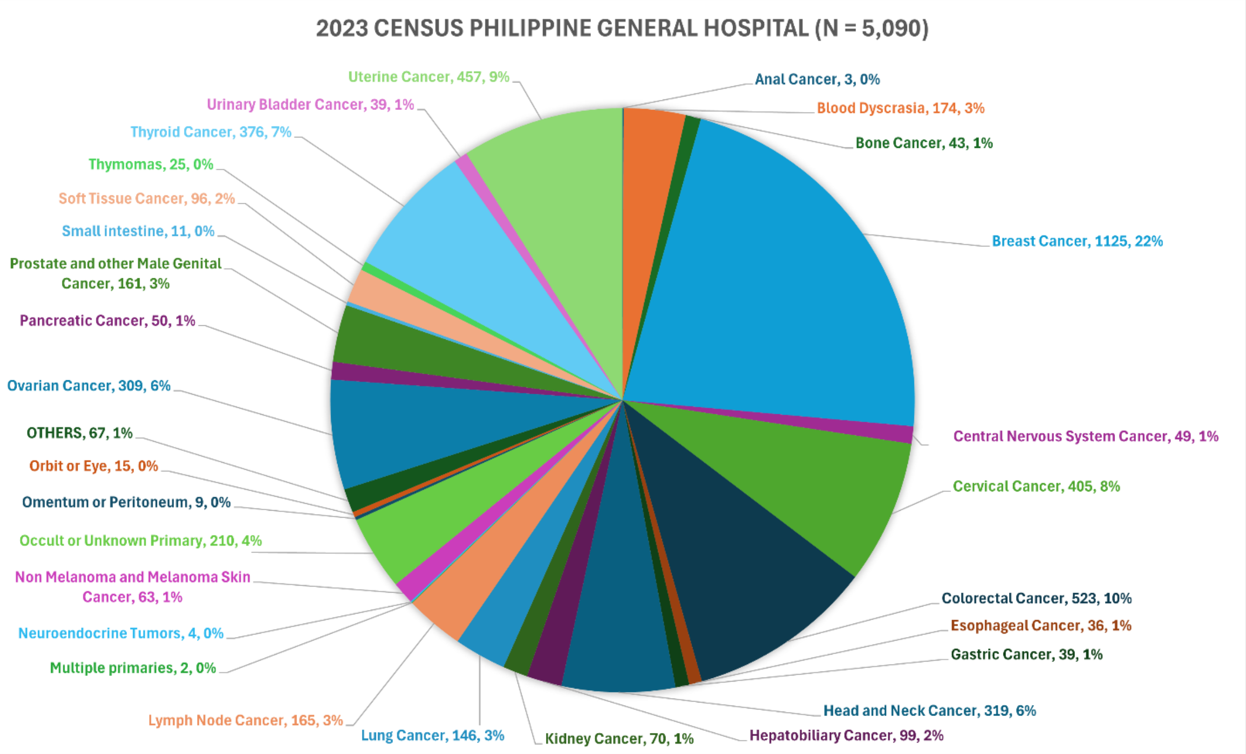


Figure 3. Frequency of primary cancer sites in PGH cancer census 2023 (based on surgical pathology reports)

Cancer data from the Philippine General Hospital relies heavily on the Surgical Pathology and Cytology reports from its Pathology Department, which are accessed through its Open Medical Records system (OpenMRS). The 5,090 new cancer patients diagnosed or treated in PGH in 2023 reflected in its current CARE PH-PGH Hospital-Based Cancer Registry is probably an underestimation of the actual number of new PGH childhood and adult cancer patients, and the interdisciplinary PGH Cancer Working Group (headed by PGH Director Gerardo Legaspi) is currently finding ways to fill these gaps by working closely with its IT Department and clinical process flow experts, and by consolidating the hospital cancer registries of CARE PH, of the Records Section, and of the Pediatric Oncology Section.

The Consolidated PGH Hospital-Based Cancer Registry

New PGH cancer patients who (1) were not diagnosed through a biopsy; (2) required confirmatory tests not done in PGH; (3) were not biopsied in PGH but sought treatment in PGH, will not be counted in the current CARE PH-PGH database. To get a more accurate picture of the cancer burden in PGH in 2023, other strategies were employed. This included acquiring a list of new patients seen at the Cancer Institute from the Medical Records Division, which was then cross-checked with the existing HBCR. If the patient was diagnosed with cancer as noted in his/her clinical history but not previously encoded in the HBCR, the patient was encoded using clinical judgment as basis. Another strategy employed was acquiring a list of new patients seen at the Pediatric Oncology clinic, as it was noted that pediatric cases were often missed due to no diagnostic biopsies done at the PGH. This list then underwent the same process of cross-checking with the HBCR.

The above strategies yielded an additional 516 registrants, giving a total of 5,606 registrants in 2023.

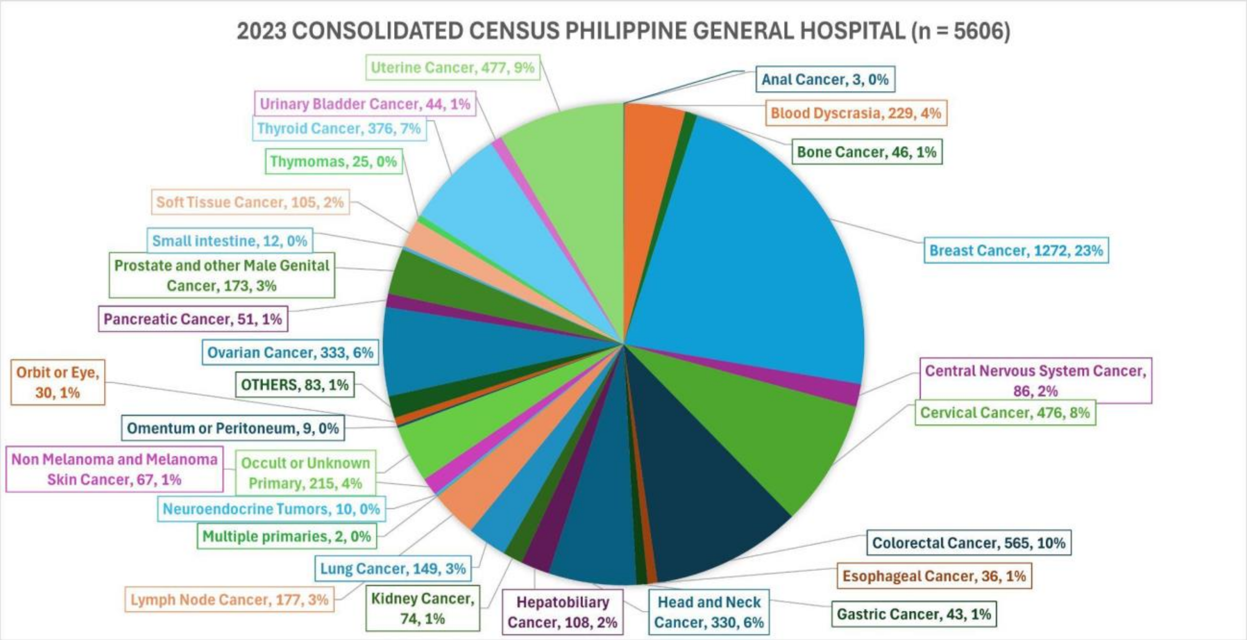


Figure 4. Consolidated frequency of primary cancer sites in PGH cancer census 2023 (based on surgical pathology reports, and records from the Medical Records Division and Pediatric Oncology clinic)

Table 3. Consolidated PGH HBCR frequencies per primary site

Primary Site	Frequency	Adjusted Frequency	% Change in Total	% of Total
Blood Dyscrasia	*174*	*229*	*+ 1%*	*4%*
Breast Cancer	*1125*	*1272*	*+ 1%*	*23%*
Central Nervous System Cancer	*49*	*86*	*+ 1%*	*2%*
Orbit or Eye	*15*	*30*	*+ 1 %*	*1%*
Neuroendocrine Tumors	*4*	*10*	*0%*	*0%*
Bone Cancer	43	46	0%	1%
Cervical Cancer	405	476	0%	8%
Colorectal Cancer	523	565	0%	10%
Gastric Cancer	39	43	0%	1%
Head and Neck Cancer	319	330	0%	6%
Hepatobiliary Cancer	99	108	0%	2%
Kidney Cancer	70	74	0%	1%
Lung Cancer	146	149	0%	3%
Lymph Node Cancer	165	177	0%	3%
Non-Melanoma and Melanoma Skin Cancer	63	67	0%	1%
Occult or Unknown Primary	210	215	0%	4%
Others	67	83	0%	1%
Ovarian Cancer	309	333	0%	6%
Pancreatic Cancer	50	51	0%	1%
Prostate and Other Male Genital Cancer	161	173	0%	3%
Small Intestine	11	12	0%	0%
Soft Tissue Cancer	96	105	0%	2%
Urinary Bladder Cancer	39	44	0%	1%
Uterine Cancer	457	477	0%	9%

From the above figures, it can be noted that there was an increase in the number of registrants with Blood Dyscrasia, from 174 to 229 registrants, giving 4% of the total, a 1% increase. There was also an increase in Breast Cancer registrants, from 1125 to 1272, giving 23%, a 1% increase; this was also the case for Central Nervous System Cancer registrants, which increased from 49 to 86, now giving 2% of the total number. Notably, the registrants under Orbit or Eye doubled in number from 15 to 30, now giving 1% of the total number of registrants; the same was noted for Neuroendocrine Tumors which increased from 4 to 10 registrants.

Increase in the number of registrants were also noted for: Bone Cancer from 43 to 46 registrants (1% of total), Cervical Cancer from 405 to 476 registrants (8% of total), Colorectal Cancer from 523 to 565 registrants (10% of total), Gastric Cancer from 39 to 43 registrants (1% of total), Head and Neck Cancer from 319 to 330 registrants (6% of total), Hepatobiliary Cancer from 99 to 108 registrants (2% of total), Kidney Cancer from 70 to 74 registrants (1% of total), Lung Cancer from 146 to 149 registrants (3% of total), Lymph Node Cancer from 165 to 177 registrants (3% of total), Non-Melanoma and

Melanoma Skin Cancer from 63 to 67 registrants (1% of total), Occult or Unknown Primary from 210 to 215 registrants (4% of total), Others from 67 to 83 registrants (1% of total), Ovarian Cancer from 309 to 333 registrants (6% of total), Pancreatic Cancer from 50 to 51 registrants (1% of total), Prostate and other Male Genital Cancers from 161 to 173 registrants (3% of total), Small Intestine from 11 to 12 registrants (0% of total), Soft Tissue Cancer from 96 to 105 registrants (2% of total), Urinary Bladder Cancer from 39 to 44 registrants (1% of total), and Uterine Cancer from 457 to 477 registrants (9% of total).

Most of the missed cases were patients with: Blood Dyscrasias (comprised mostly pediatric patients), Cervical Cancer, Hepatobiliary Cancers, Rectal Cancers, and Eye Cancers. Many were noted for "suspicion of malignancy" but were not confirmed due to lack of follow-up or confirmatory tests. A few were given case numbers with no noted laboratory or imaging encounters, with nothing to base clinical history on, these can also be deemed probable missed cases.

CHINESE GENERAL HOSPITAL

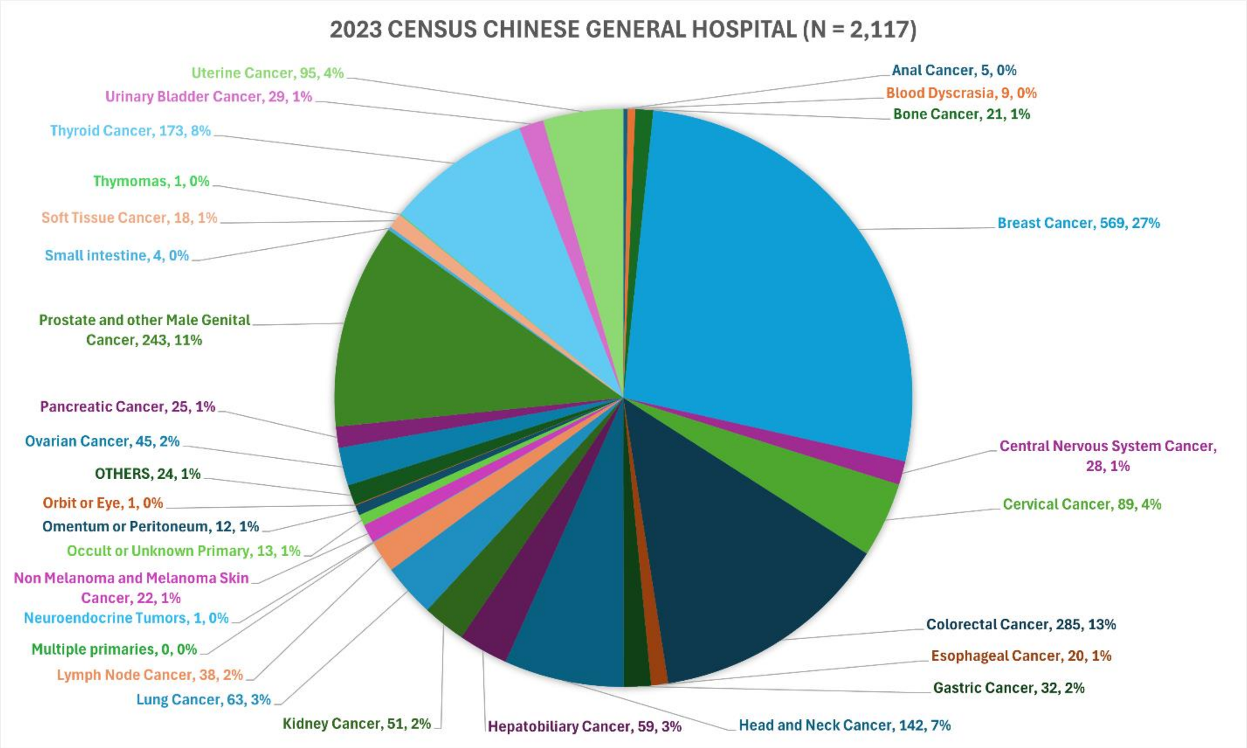


Figure 5. Frequency of primary cancer sites in CGH cancer census 2023

Chinese General Hospital is a 600-bed private hospital with a *"Cancer Center within a General Hospital"* DOH classification. CGH's growth in 2023 is highest among CARE PH private hospitals, in terms of the number of new cancer patients included in its cancer registry. The hospital's Medical Director, Dr. Samuel Ang, attributes this growth to the Cancer Center's concerted effort to improve processes and have more efficient service delivery, allowing them to accommodate more patients in their Center.

EAST AVENUE MEDICAL CENTER

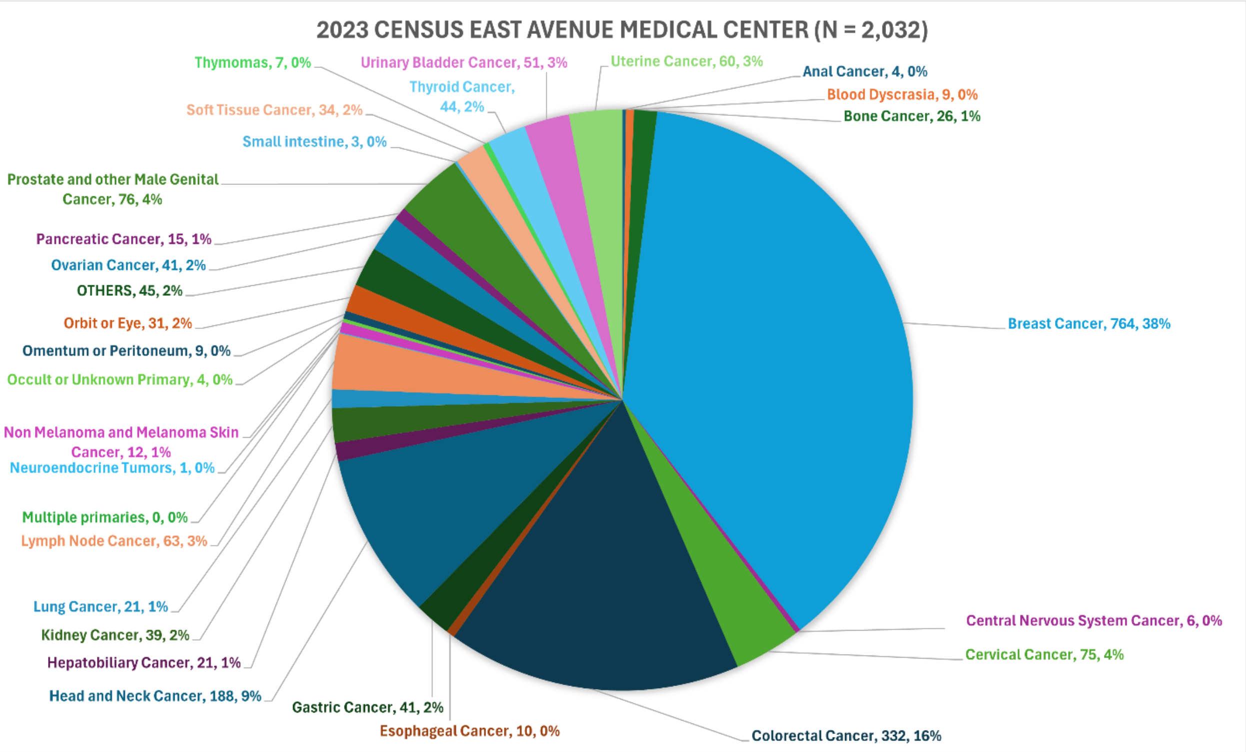


Figure 6. Frequency of primary cancer sites in EAMC cancer census 2023

East Avenue Medical Center, a 600-bed DOH hospital headed by Dr Alfonso Nunez, also has a classification of *“Cancer Center within a General Hospital”.* It has been recently designated as a Specialty Center for Breast Cancer, perhaps because 36% of their new cancer patients have this disease, versus the average of 31% in the central database of CARE PH. EAMC also has a higher than average percentage of Colorectal (16% vs 11%) and Head and Neck cancers (9% vs 6%) in their hospital cancer registry, compared with the average percentages of these cancers in the central database of CARE PH hospitals.

EAMC has the highest census among all DOH hospitals in the 2023 CARE PH HBCR.

DAGUPAN DOCTORS VILLAFLOR MEMORIAL HOSPITAL

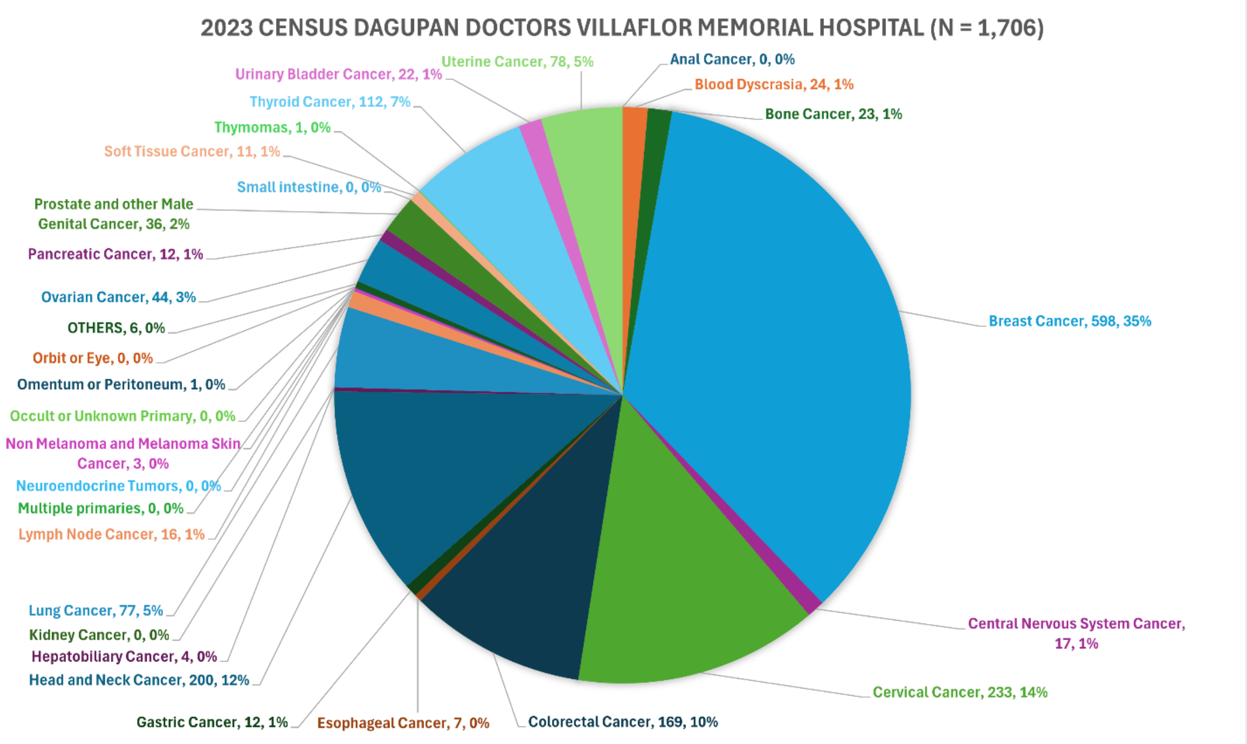


Figure 7. Frequency of primary cancer sites in DDVMH cancer census 2023

Dagupan Doctors Villaflor Memorial Hospital or DDVMH, located in Region I and headed by Dr. Vivencio Jose P. Villaflor III, continues to be the highest-ranking non-NCR contributor to the central database of CARE PH. It is a tertiary private hospital with a 125-bed capacity with a higher than 2023 CARE PH average percentage of Breast (35% vs 31%), Cervical (14% vs 6%), and Head and Neck cancers (12% vs 6%).

NATIONAL KIDNEY AND TRANSPLANT INSTITUTE

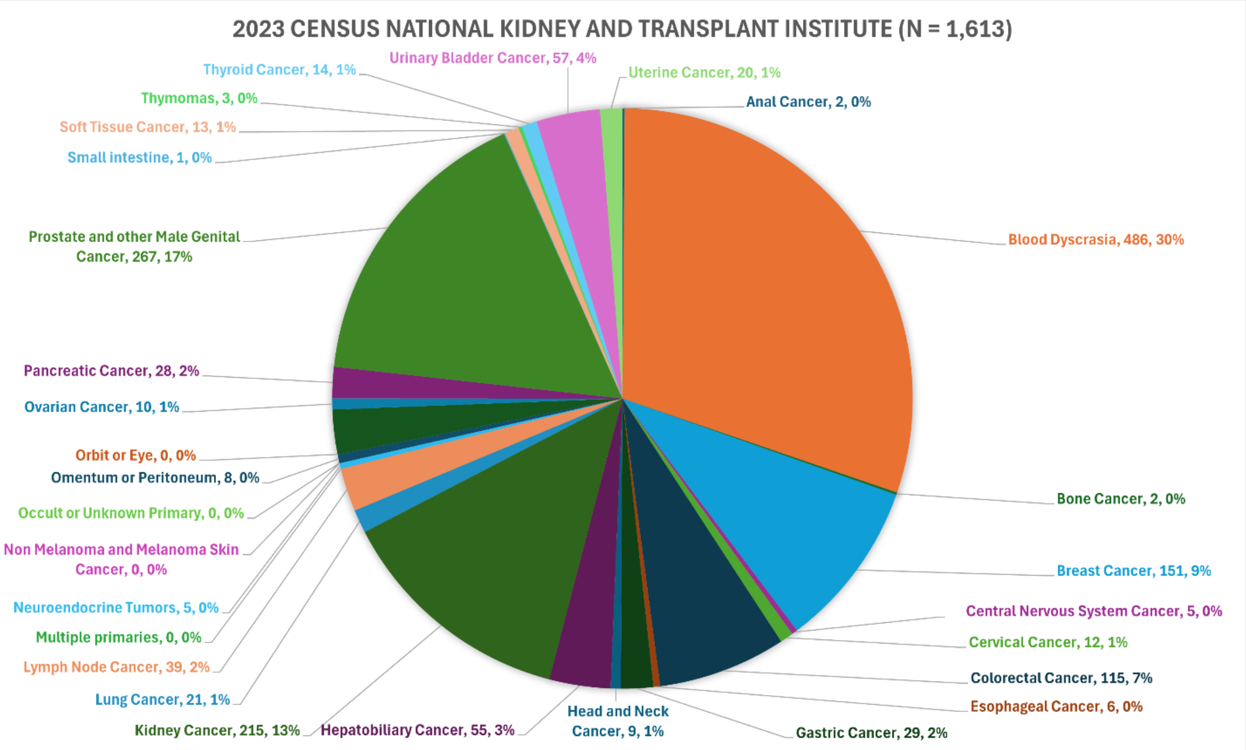


Figure 8. Frequency of primary cancer sites in NKTI cancer census 2023

The National Kidney and Transplant Institute, or NKTI, is a Specialty Cancer Center catering to patients with Kidney and other Urologic Cancers in the country. It is also the national referral center for the diagnosis of hematologic malignancies. The Executive Director of NKTI is Dr. Rose Marie Liquete.

The figure above reflects the specialized patient population served by the NKTI, with a higher than 2023 CARE PH average percentage of Blood (30% vs 4%), Prostate (17% vs 5%), and Kidney cancers (13% vs 2%).

THE MEDICAL CITY PASIG

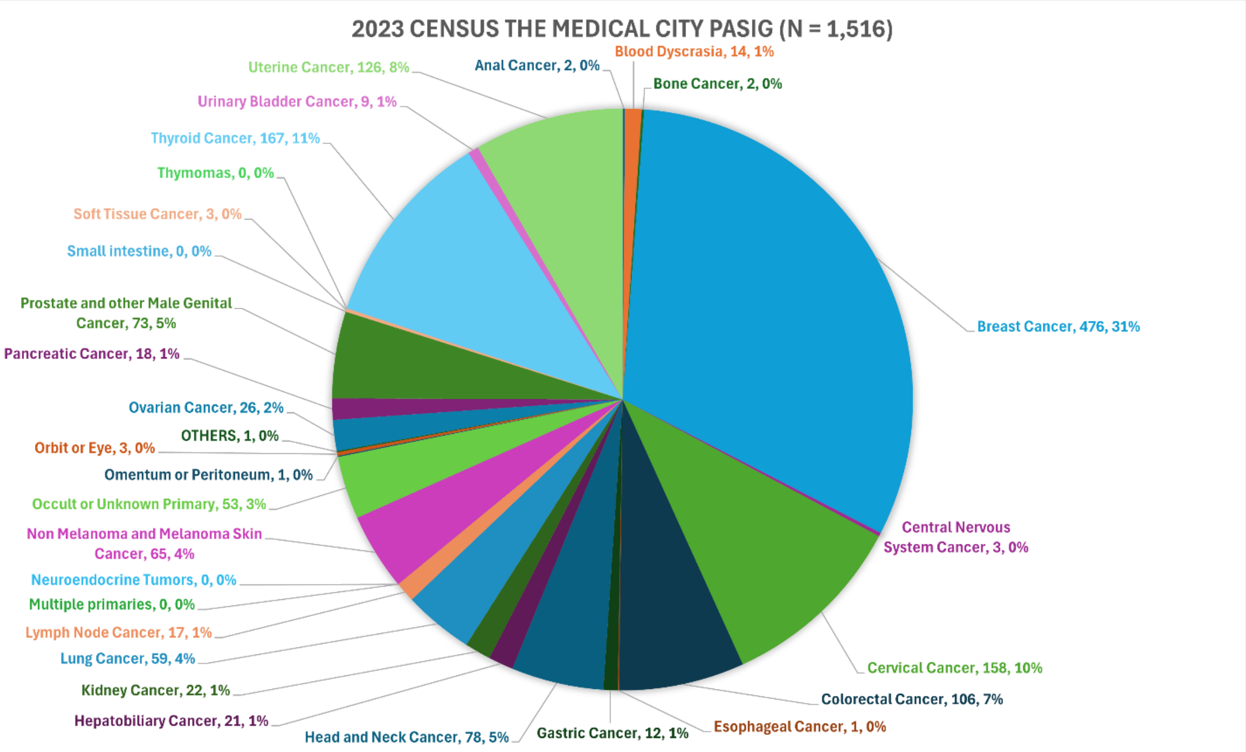


Figure 9. Frequency of primary cancer sites in TMC Pasig cancer census 2023

MAKATI MEDICAL CENTER

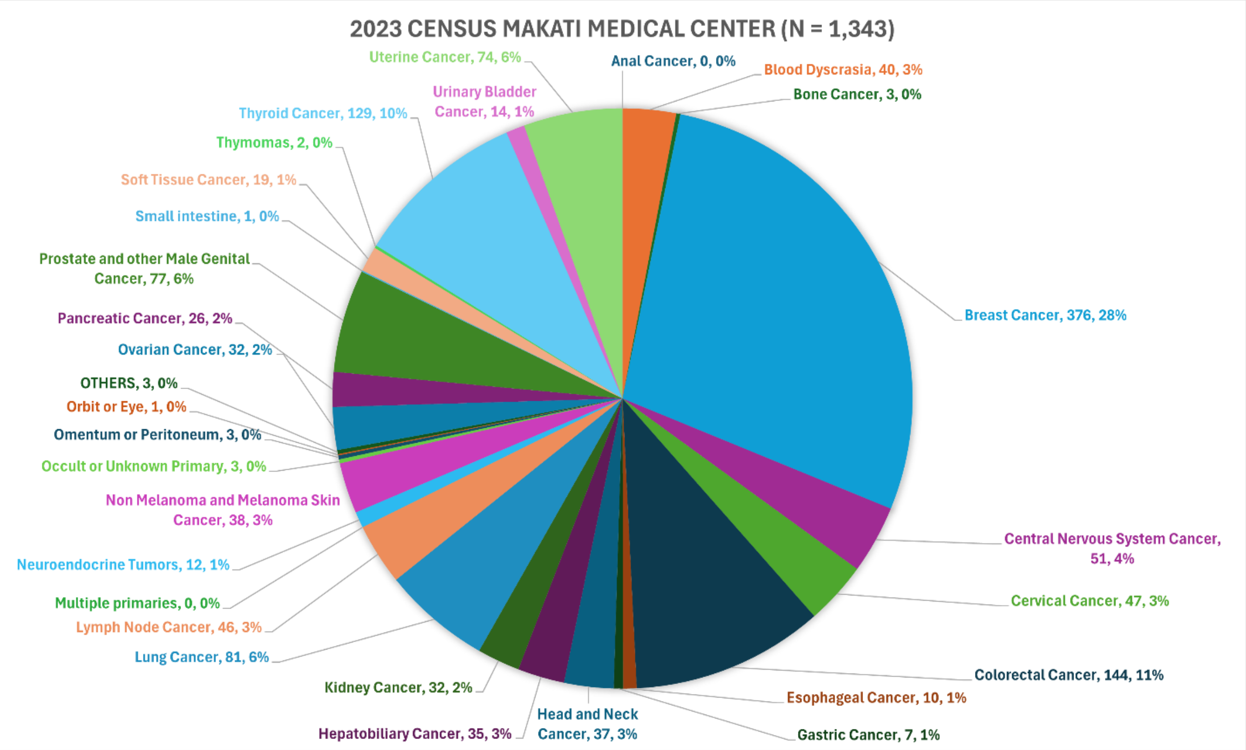


Figure 10. Frequency of primary cancer sites in MMC cancer census 2023

NORTHERN MINDANAO MEDICAL CENTER

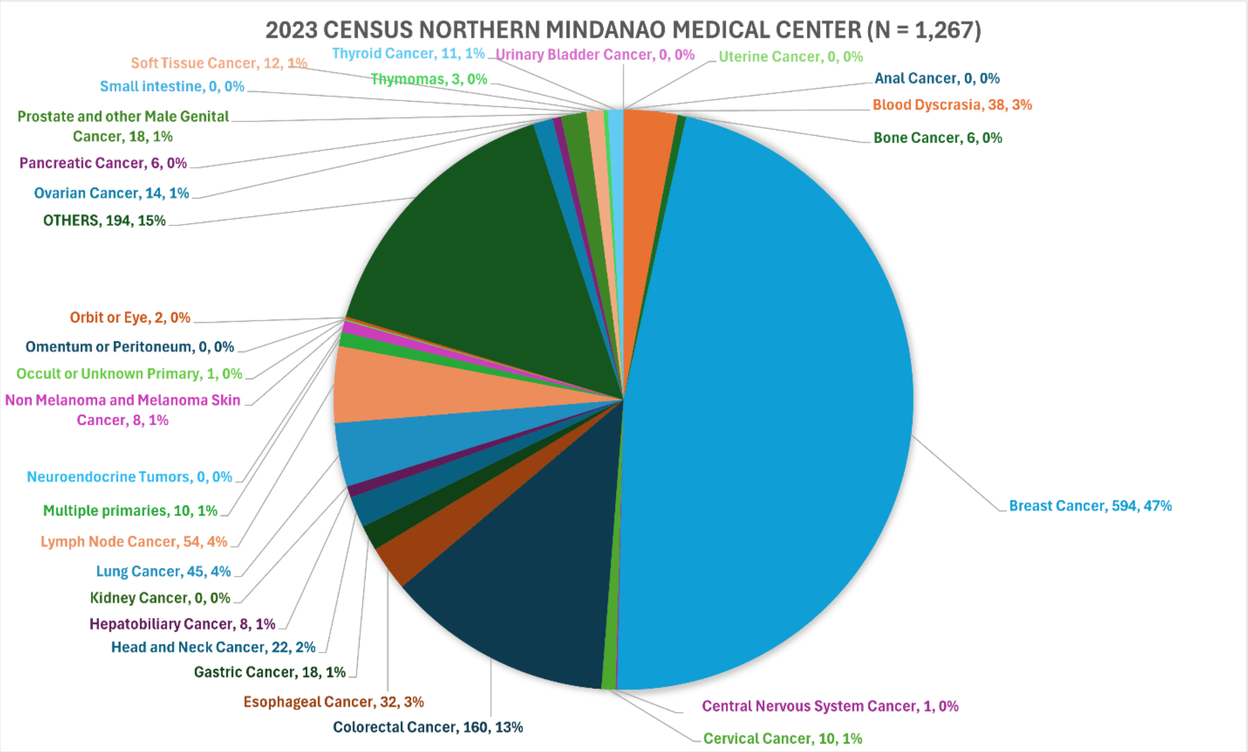


Figure 11. Frequency of primary cancer sites in NMMC cancer census 2023

BICOL MEDICAL CENTER

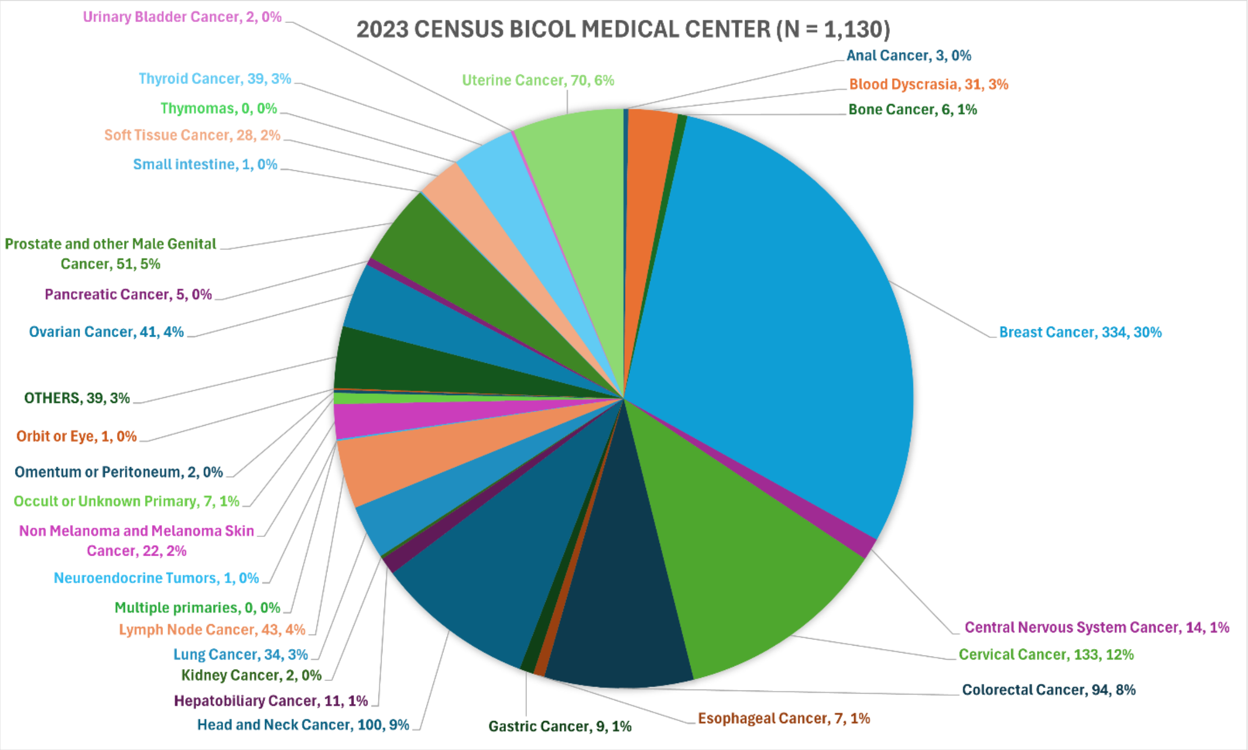


Figure 12. Frequency of primary cancer sites in BMC cancer census 2023

CARDINAL SANTOS MEDICAL CENTER

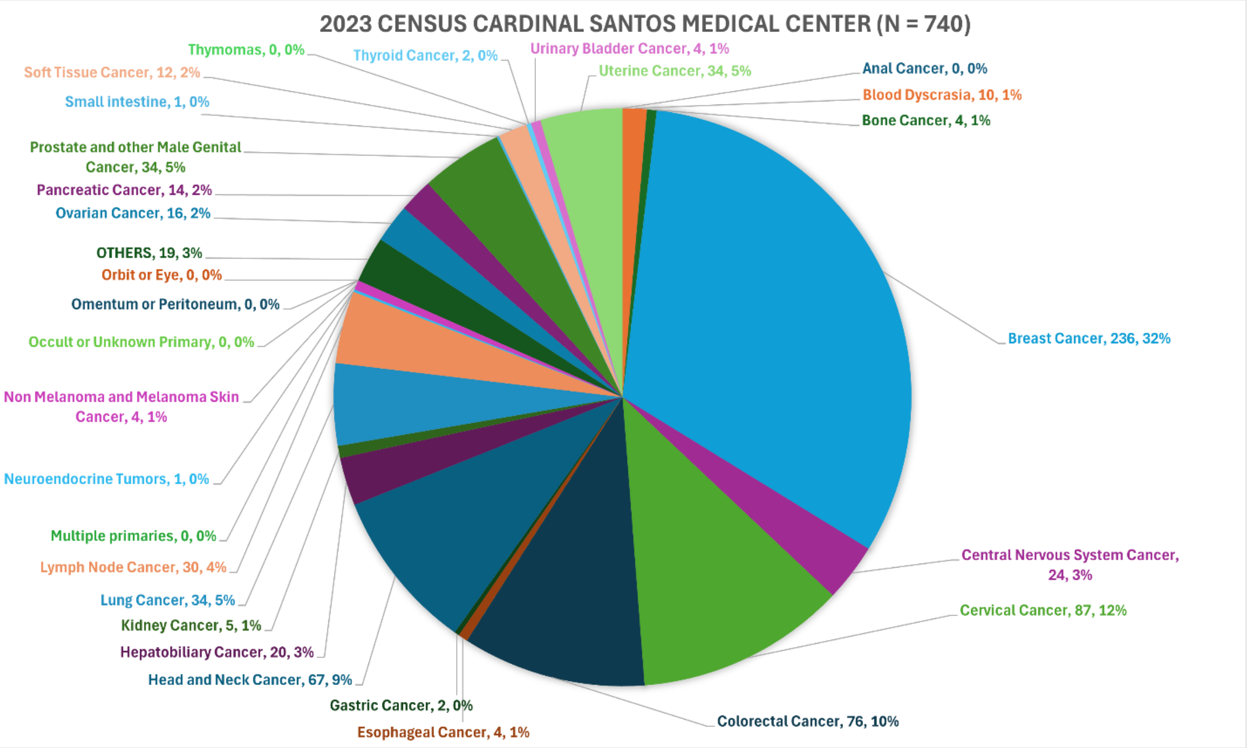


Figure 13. Frequency of cancer primary cancer sites in CSMC cancer census 2023

The Cancer Centers of The Medical City Ortigas, Makati Medical Center, Northern Mindanao Medical Center, Bicol Medical Center, and Cardinal Santos Medical Center round up the top 10 CARE PH hospitals with the highest number of new patients diagnosed or treated for cancer in 2023.

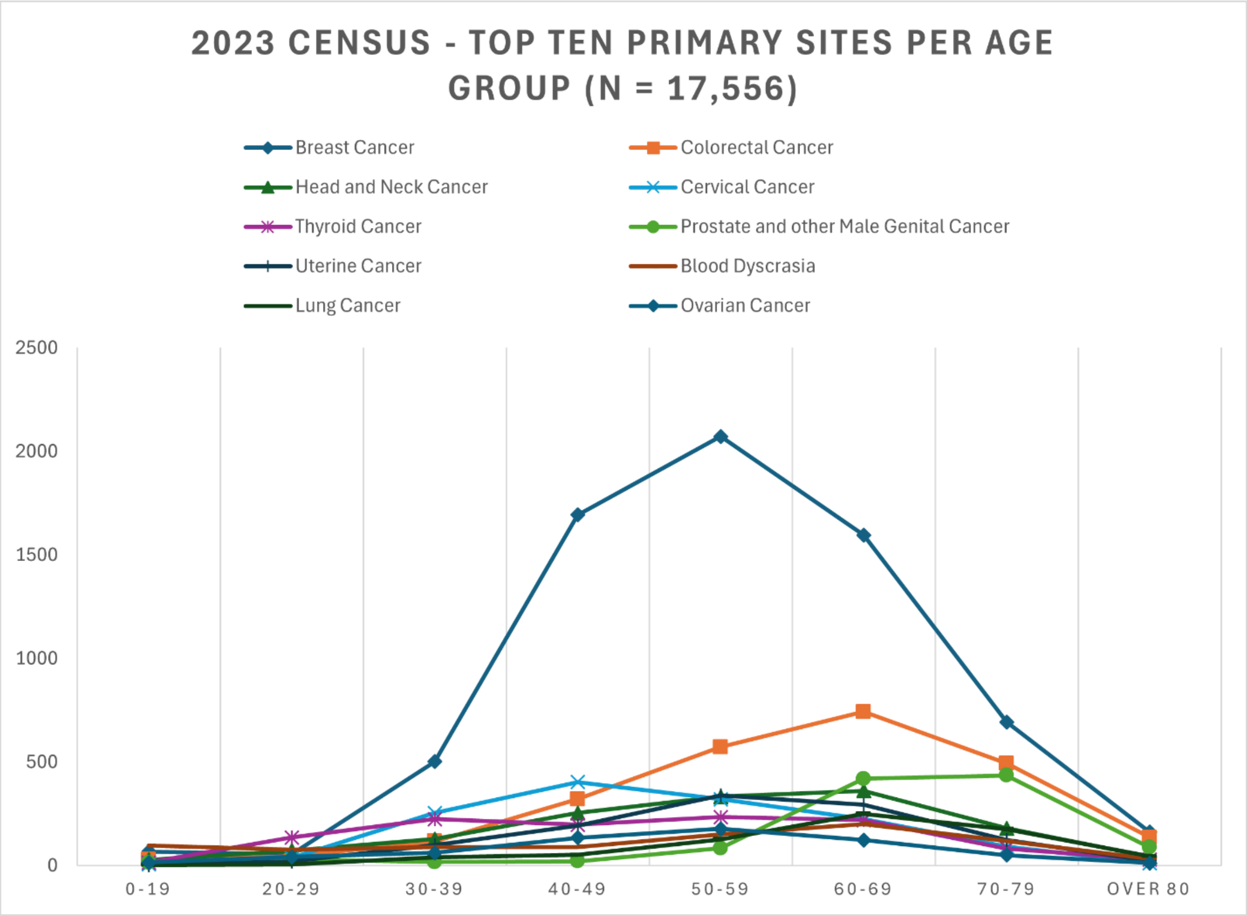


Figure 14. Top 10 primary sites by age group in 2023

Figure 14 above shows that new breast cancer cases far outnumber the second most commonly diagnosed or treated cancer in the CARE PH hospitals (Colorectal Cancer). The line graph also shows that Breast Cancer peaks at age 50-59, while Colorectal Cancer peaks at age 60-69 years. Head and Neck Cancer is the third and Cervical Cancer is the fourth most frequent cancer seen in CARE PH hospitals and peaks at 60-69 years and 40-49 years of age respectively. Rounding up the top 5 is Thyroid Cancer which peaks at 50-59 years of age.

Table 4 below shows the age distribution of the top ten CARE PH cancer sites. Red highlighted cells show the highest number of new registrants per primary site. Yellow highlighted cells show the next highest number of new registrants per primary site. Note that the table lists the age at which the cancer patients are entered into the CARE PH Cancer Registry system. Since the registry enlists only those newly diagnosed or treated in the CARE PH site, the underlying assumption is that the patient is diagnosed in a CARE PH hospital and/or treated in a CARE PH hospital within one year of each other.

As was observed in 2022, 80% of all the cancers seen in CARE PH hospitals in 2023 is attributed to the top ten cancers seen in Table 3. Breast, Uterine and Ovarian cancers, found in women, and Thyroid cancer found in both men and women, have peak incidence between ages 50-59 years. Another female malignancy, Cervical cancer peaks at 40-49 years. Prostate and other Male Genital cancers peak at 70-79 years old, which is noted to be a decade older than the site’s peak in 2022 data. All other cancers found in men or men and women peak between 50 to 69 years old.

Of note, more than a third (35%) of the top ten cancers in the age group 0-19 are Blood dyscrasias (childhood leukemias), with a noted increase in the number of Breast cancer registrants in this age group.

Table 4. Age distribution of top 10 CARE PH primary sites

Primary Site	0-19	20-29	30-39	40-49	50-59	60-69	70-79	Over 80	Empty	Total
Breast Cancer	68	56	502	1694	2073	1596	693	162	1	6845
Colorectal Cancer	28	45	117	320	572	743	494	136	0	2455
Head and Neck Cancer	28	73	128	254	333	362	180	42	0	1400
Cervical Cancer	6	37	254	403	321	225	91	12	0	1349
Thyroid Cancer	15	136	224	198	235	219	83	29	0	1139
Prostate and other Male Genital Cancer	13	29	17	21	84	420	436	87	1	1108
Uterine Cancer	3	19	98	193	339	293	123	23	0	1091
Blood Dyscrasia	96	77	89	90	151	201	118	32	0	854
Lung Cancer	4	6	39	52	127	250	176	44	0	698
Ovarian Cancer	15	42	62	134	178	123	50	12	1	617
TOP TEN OVERALL	**276**	**520**	**1530**	**3359**	**4413**	**4432**	**2444**	**579**	**3**	**17556**
TOTAL OVERALL	**506**	**792**	**1879**	**3876**	**5282**	**5536**	**3146**	**795**	**4**	**21816**
% Top Ten of Overall	**55%**	**66%**	**81%**	**87%**	**84%**	**80%**	**78%**	**73%**	**75%**	**80%**

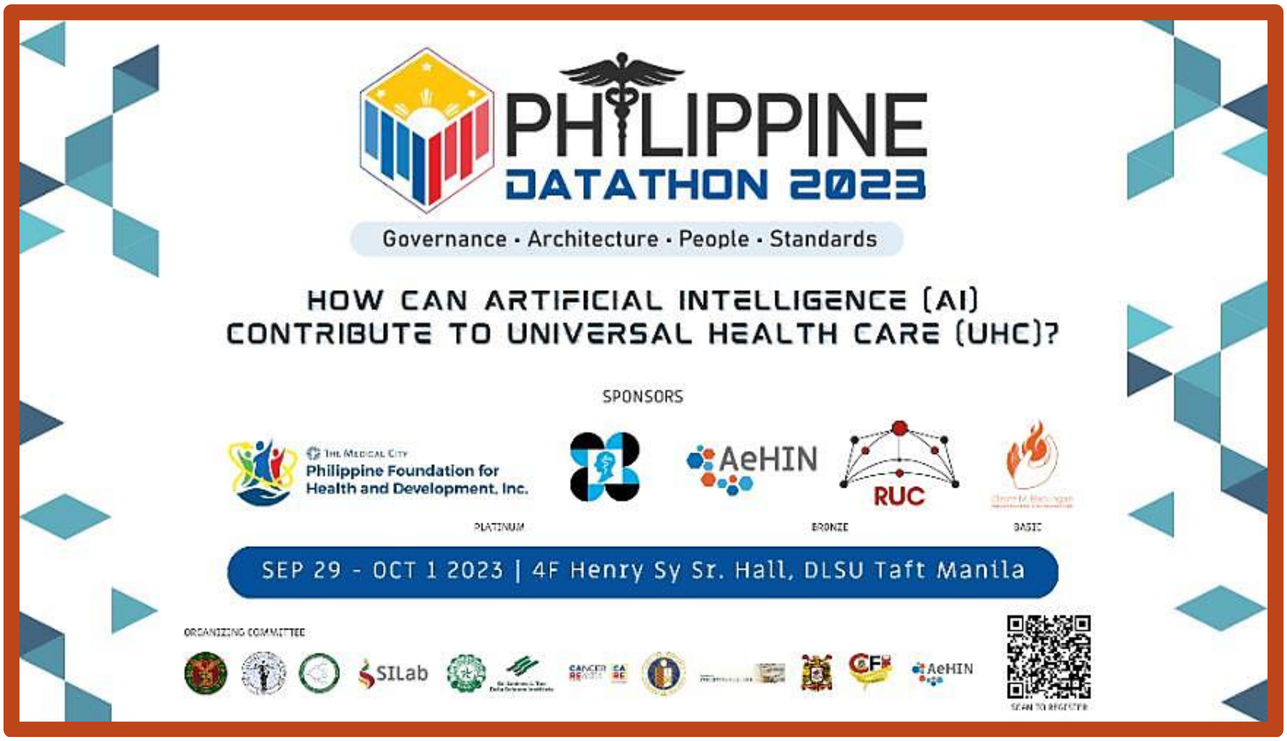
CARE PH 2023-2024 RESEARCH

CARE PH PLOS ARTICLE

The 2017-2022 data in the Central CARE PH database was cleaned and analyzed in 2023 to create a proof-of-concept paper on the challenges in the maintenance of an open disease-specific registry. It was written to tell the story of a hospital-based cancer registry system—its people, process and technology components, the real-life experience of its creation, and the challenges met on the ground, given the required data fields of the registry and the limitations of the current landscape in information technology in a low-to-middle income country (LMIC). The lessons learned are useful as we work towards the global United Nations Sustainable Development Goal of Good Health and Wellbeing by the year 2030, and the local government programs of universal healthcare and cancer control by 2030.

The article *"Challenges in the Maintenance of an Open Hospital-Based Cancer Registry System in a LMIC"* (https://doi.org/10.1371/journal.pdig.0000328) was published in January 2024 on PLOS Digital Health, an interdisciplinary Open Access journal publishing boundary-breaking original academic and clinical research that uses open science practices, digital tools, technologies, and data science to significantly advance human health and health care. The full article can be found in Appendix A of this annual report.

2023 PHILIPPINE DATATHON



Empowering Health Data Science Through the Philippine Datathon: How Artificial Intelligence Can Contribute to Universal Health Coverage

Last September 30 - October 1, 2023, the 2023 Philippine Datathon was held at the De La Salle University in Taft Avenue, Manila. This 3-day event aimed to convene advocates of health data governance and management to explore the integration of artificial intelligence (AI) within the health sector's UHC initiative. It was the third in a series following previous conferences such as Big Data Philippines in 2017 and 2018. The event utilized a dynamic approach incorporating lectures, panels, workshops, and a competition (Datathon) to foster active participation and collaboration among attendees. Key insights were distilled from presentations used by the speakers.

The Datathon successfully cultivated a network of institutions and individuals committed to advancing data governance and management. Critical discussions surfaced recurring challenges and ethical considerations necessary for the responsible use of AI in healthcare, which were meticulously documented for future reference.

The Philippine Datathon 2023 underscored the critical role of a united community in driving forward the ethical application of AI in healthcare. It highlighted the necessity for ongoing dialogue to demystify AI's complexities and leverage its potential responsibly. The Datathon set the stage for future collaborations aimed at enhancing public health outcomes through innovative data-driven approaches, reinforcing the imperative for ethical consideration and community engagement in the evolving landscape of health data management and AI.

The full report of the 2023 Philippine Datathon can be seen in Appendix B of this annual report.

2024 CARE PH-PGC MOU

The Philippine Genome Center and CARE PH, both aim *“to facilitate cancer research and the building of a Philippine Cancer Precision Medicine Platform (PCPMP)”.* With this end in mind, a Memorandum of Understanding was signed by the President of the UP System, the Executive Director of the PGC, the President and CEO of CARE PH, and the Treasurer of CARE PH.

Mutual covenants were set and agreements reached regarding joint action, information sharing, mutual support and acknowledgement of data.

A copy of the MOU between CARE PH and PGC is seen in Appendix C.

2024 CARE PH ORIGINAL STUDY

Health and wellbeing for all is one of the United Nations' sustainable development goals for 2030. The establishment of an accessible and equitable healthcare system is the global approach towards achievement of this goal. In the Philippines, the Universal Healthcare Act was enacted in 2019, and its implementing rules and regulations were published soon after its enactment.

The establishment of an accessible and equitable cancer healthcare ecosystem is likewise the goal of RA 11215, otherwise known as the National Integrated Cancer Control Act (NICCA) of 2019. In its declaration of policy, Section 2 declares *“(The State) shall likewise make cancer prevention, screening, diagnosis, treatment and care more equitable, affordable, and accessible for all, especially for the underprivileged, poor and marginalized Filipinos.”*

Foundational to the establishment of public health services and programs, including cancer control programs, is the assessment and monitoring of population health. Last July 2024, CARE PH was able to secure funds from an anonymous donor with special interest in public health and health economics.

The CARE PH research team created a survey on the health related symptoms, needs and wants of the Filipino public, with specific questions regarding the presence or absence of any of the early warning signs of cancer, with the goal in mind of assessing the health status of 2 sample Filipino barangays, as proof of concept of the use of this research tool in assessing and monitoring population health, in aid of early detection of cancer in Filipino communities.

A copy of the research protocol is seen in Appendix D of this annual report.

CARE PH FINANCIAL SUMMARY
(per 2023 AFS)

BOH 2023		**19,128**
● BPI	7,569	
● RCBC	11,559	
CONTRIBUTIONS AND GRANTS		**2,044,998**
● APSCI	220,500	
● WAI	230,300	
● PSUO	499,570	
● Philippine Foundation for Health and Development	300,000	
● Philippine Science High School 1979	150,000	
● DOST-PCHRD	299,695	
● AeHIN	99,325	
● Datathon 2023	100,000	
● Anonymous Donors	145,608	
EXPENSES		**2,182,094**
● Program and Project	1,989,975	
● General and Administrative *	192,119	
EOH 2023		**4,098**
● BPI	4,098	
● RCBC	0.00	

*Compliant to Tax Code SEC 34-H.2.c.3

“The level of administrative expense of which shall, on an annual basis, conform with the rules and regulations to be prescribed by the Secretary of Finance, upon recommendation of the Commissioner, but in no case to exceed thirty percent (30%) of the total expenses”

[*8.80% | Best practice ≤ 15%]

APPENDIX A

PLOS DIGITAL HEALTH

RESEARCH ARTICLE

Challenges in the maintenance of an open hospital-based cancer registry system in a low-to-middle-income country (LMIC): 2017–2022 experience

Beatrice Tiangco[1,2], **Shanaia Esthelle Joy Daguit**[1], **Nicole Cathlene Astrologo**[1,3], **Leo Flores**[1], **Ric Nonato Parma**[1], **Leo Anthony Celi**[4,5,6]*

1 Cancer CARE Registry and Research Philippines Foundation, Inc, Pasig, Philippines, **2** University of the Philippines National Institutes of Health, Manila, Philippines, **3** University of the Philippines Los Baños, Los Baños, Philippines, **4** Laboratory for Computational Physiology, Massachusetts Institute of Technology, Cambridge, Massachusetts, United States of America, **5** Division of Pulmonary, Critical Care and Sleep Medicine, Beth Israel Deaconess Medical Center, Boston, Massachusetts, United States of America, **6** Department of Biostatistics, Harvard T.H. Chan School of Public Health, Boston, Massachusetts, United States of America

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Abstract

Hospital-based cancer registries (HBCRs) record data on all patients diagnosed and/or treated for cancer at healthcare facilities and evaluate the burden of the disease and the quality of healthcare services at that hospital, helping improve patient care, and providing an assessment of healthcare quality. The CARE PH app was created as a tool to facilitate a system of hospital-based cancer registries in the Philippines, a lower middle-income country. From 2017 to 2022, a total of 60,021 cancer registrants from 44 CARE PH hospitals were entered into the database. Breast cancer was the most common primary site, accounting for 17,660 cases (29.4%). This was followed by colorectal cancer at 11.1%, cervical cancer at 6.2%, head and neck cancer at 5.9%, and prostate and other male genital cancer at 5.1%.Among the 30 data fields collected, 17 exhibited 0–20% missing data, eight displayed 21%-90% missing data, while five depicted 91%-100% missing data. Most of the data fields with missing data are in the treatment and follow-up modules, which are stored in separate forms in a patient's record. Digital transformation of hospitals from paper-based charts to electronic medical records, and the integration of the HBCR to the EMR and hospital information system, will likely be the best solution for these limitations. It is recommended that the creation and maintenance of HBCRs nationwide must be harmonized, and embedded in all relevant national programs and legislations. The development of an information technology process that is based on a cancer patient's journey, should be built on an open system embedded in a well designed enterprise architecture, functioning under the guidance of a strong leadership and governance team. All these must be present in order to create and maintain a robust HBCR that is useful for furthering cancer registry and research in the country.

OPEN ACCESS

Citation: Tiangco B, Daguit SEJ, Astrologo NC, Flores L, Parma RN, Celi LA (2024) Challenges in the maintenance of an open hospital-based cancer registry system in a low-to-middle-income country (LMIC): 2017–2022 experience. PLOS Digit Health 3(1): e0000328. https://doi.org/10.1371/journal.pdig.0000328

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Data Availability Statement: The data that support the findings of this study are openly available in figshare at http://doi.org/10.6084/m9.figshare.23665113.

Funding: CARE PH, through BJT, received funding for the initial establishment of the HBCR app from the Philippine Society of Medical Oncology (no grant number) (https://psmo.org.ph/), the

Philippine College of Physicians (no grant number) (https://pcp.org.ph/), and the Philam Foundation through the ALPHA 1 Project (https://www.aia.com.ph/en). LAC is funded by the National Institute of Health through NIBIB R01 EB017205 (https://www.nih.gov/). The sponsors did not play any role in the study design, data collection and analysis, decision to publish and preparation of the manuscript.

Competing interests: Leo Anthony Celi is on the PLOS Computational Biology editorial board. The authors declare no other competing interests in this work.

Author summary

This is a proof-of-concept paper on the challenges in the maintenance of an open disease-specific registry. It tells the story of a hospital-based cancer registry system—its people, process and technology components, the real-life experience of its creation, and the challenges met on the ground, given the required data fields of the registry and the limitations of the current landscape in information technology in a low-to-middle income country (LMIC). The lessons learned are useful as we work towards the global United Nations Sustainable Development Goal of Good Health and Wellbeing by the year 2030, and the local government programs of universal healthcare and cancer control by 2030.

Introduction

A cancer registry is an information system or database designed for the collection, storage, and management of cancer data from a specified population, which gives its end-users a snapshot of the real-world cancer burden [1]. Although cancer registries were originally used to calculate rates of incidence, and compare risk of various cancers in different populations, developments have helped them evolve to include studies of cancer cause and prevention. Collected registry data now also serve as a primary resource for epidemiological, causality, feasibility and effectivity research, as well as provide critical information needed in planning and evaluating cancer prevention and control interventions [1–3]. There are two major types of cancer registries: population-based registries, and hospital-based registries [1]. Population-based cancer registries (PBCRs) record all cases in a geographically defined population from multiple sources and measure the impact of the disease in specific demographics such as age, gender, etc. PBCRs are designed to determine cancer patterns and trends, guide health policies in surveillance, control and funding, as well as advance clinical, epidemiological, and health services research [3].

On the other hand, hospital-based cancer registries (HBCRs) record data on all patients diagnosed and/or treated for cancer at a particular healthcare facility and evaluate the burden of the disease and the quality of healthcare services at that hospital. The primary focus is on improving patient care at that hospital, as well as on administrative processes, clinical research, and professional education [1,2]. HBCRs are used mainly to provide an assessment of patients' needs, cancer programs, and health care quality within a health institution [3].

A systematic review of hospital based cancer registries (HBCRs) conducted in 2017 noted that HBCRs are mostly used for management of cancer programs and improving quality of care. Other functions include epidemiological and clinical research, education, policy making, evaluation of implantation of clinical practice guidelines, planning and monitoring of cancer control programs, including prevention, screening, treatment, and palliative care. HBCRs remain an important resource for planning and monitoring of cancer control programs, as they play a role in the improvement of quality of care of cancer patients [4].

Several countries have already established HBCRs, including Japan with 397 HBCRs [5] which provide evidence for clinical measurements and create more accurate health policies for its population. HBCRs have also been established in low- and middle-income countries such as Colombia [6] and Nigeria which has 19 HBCRs [7]. These registries have been useful in improving cancer programs, providing a better understanding of the region's response capability against cancer, and giving an optimal coverage of cancer data. Such strategies are important in low- to middle-income countries with weak surveillance systems and scarce financial, human, and infrastructural resources for cancer management and control [4–7].

In the Philippines, a lower middle-income country with a population of 109 million, 69.4 million of which are in the 15–64 working age group [8], there is still no centralized population-based cancer registry, but rather separate PBCRs led by local government units in different provinces such as the Department of Health-Rizal Cancer Registry (DOH-RCR), Philippine Cancer Society-Manila Cancer Registry (PCS-MCR), Cebu Cancer Registry (CCR) and Davao Cancer Registry (DCR) [5]. These PBCRs utilize an active method of data collection, to provide information used as the basis for most cancer prevention programs and activities of the Department of Health [9], but these do not often include clinical data, thus limiting the assessment of important variables, such as accuracy of diagnosis, quality of treatment, demand for health services, among others [10].

Although the benefits of implementing an HBCR have been evidenced, it has been observed that its success over time requires interest from the institution, engagement of stakeholders, and financial support. Ethnic variations and environmental influences also make incidence of cancer variable across different populations, hence making it mandatory to have patient databases in every hospital, so that region specific data may be created and policies formulated.

This is a follow-up paper on the Creation and Maintenance of a Hospital-Based Cancer Registry (HBCR) System [11]. The objective of this study is to describe the researchers' experience in implementing the Cancer CARE Registry and Research Philippines' (CARE PH) Hospital-based Cancer Registry (HBCR) System in the six years since it started data gathering.

Methodology

Implementation and building a database

CARE Philippines (CARE PH) started out as a software tool created in a collaboration between a practicing Medical Oncologist and Epidemiologist, and a Health Information Technology specialist through consultations with different stakeholders such the Department of Health (DOH) Knowledge Management and Information Technology Service (DOH-KMITS), hospital cancer committees, cancer specialists, and cancer researchers, for gathering demographic and clinical information to help the Department of Health determine incidence of disease and prioritize public health activities.

It has since evolved into a loose organization of hospitals (CARE PH Hospitals) and their registry staff that use the CARE PH app for their hospital cancer registry. Each hospital has the CARE PH app embedded into their local area network, kept secure by the hospital IT department or tumor registry office; it has a capacity to share anonymized data with a secure central database. The summary data from all participating hospitals is published in yearly reports presented to the member hospitals, and is also made available in the organization website (https://careph.org).

Ethics statement and data privacy

The CARE PH HBCR System complies with the Philippine government's Data Privacy Act of 2012 and was piloted in 2015 at the National Kidney and Transplant Institute (NKTI), a government-owned specialty hospital, and at The Medical City Pasig (TMC), a privately-owned tertiary hospital. CARE PH first submitted its proposal to these hospitals' ethics regulatory boards which then approved the protocol and informed consent process. Formal written consent was obtained from patients enrolled from the first two hospitals. Subsequent hospital members and their medical directors signed memorandums of agreement with CARE PH where the hospital agreed to use the CARE PH app as their hospital cancer registry and share their anonymized and encrypted cancer registry data with the central CARE PH database which collected only summarized and de-identified registry data.

At the hospital level, all patients need to be informed that the hospital maintains a cancer registry database that contains personal information about those diagnosed with and or treated for cancer within the hospital.

With the passing of Republic Act No. 11215 –the National Integrated Cancer Control Act (NICCA) in 2019 [12], adult and childhood cancers were considered as a notifiable disease in all levels of the healthcare system and required to be reported to the Department of Health. Cancer patients can opt out of the registry by putting in writing their opt out preference, signing and dating such written statements.

Population and hospital membership

Over the past six years, CARE PH has established Memoranda of Agreement with a total of 44 hospitals with cancer centers, 10 of which are newly onboarded in 2022, as demonstrated in Table 1. Among these, 37 are categorized as tertiary hospitals, five as secondary hospitals, one as a primary care hospital, and one as a standalone cancer center. Geographically, nine of these hospitals are located within the National Capital Region (NCR), while 19 are situated in Luzon (outside NCR), eight in the Visayas, and another eight in Mindanao. Furthermore, the distribution indicates that 15 of these hospitals operate under government management, while 29 are privately owned.

Table 1. List of CARE PH hospitals with corresponding level and type of service and bed capacity.

Hospital Name	Level	Type	Bed Capacity
NCR (n = 9)			
1. Cardinal Santos Medical Center	Tertiary	Private	245
2. Chinese General Hospital	Tertiary	Private	600
3. Dr. Jose N. Rodriguez Memorial Hospital and Sanitarium	**Tertiary**	**Government**	**2,000**
4. East Avenue Medical Center	Tertiary	Government	600
5. Makati Medical Center	Tertiary	Private	600
6. Medical Center Manila	Tertiary	Private	200
7. National Kidney and Transplant Institute	Tertiary	Specialty Government	500
8. Philippine General Hospital	Tertiary	Government	1,500
9. The Medical City Ortigas	Tertiary	Private	600
LUZON (n = 19)			
1. Baguio Medical Center	Primary	Government	500
2. Batangas Medical Center	Tertiary	Government	500
3. Bicol Medical Center	Tertiary	Government	500
4. Bicol Regional Training and Teaching Hospital	Tertiary	Government	600
5. Calamba Medical Center	**Tertiary**	**Private**	**122**
6. Dagupan Doctors Villaflor Memorial Hospital	Tertiary	Private	125
7. De La Salle University Medical Center	**Tertiary**	**Private**	**300**
8. Divine Grace Medical Center	**Tertiary**	**Private**	**75**
9. Global Care Cancer Institute	n/a	Standalone	n/a
10. Mary Mediatrix Medical Center	**Tertiary**	**Private**	**174**
11. Naga Imaging Center Cooperative Doctors Hospital	Tertiary	Private	99
12. Palawan MMG Cooperative Hospital	Tertiary	Private	80
13. Rizal Medical Center	Tertiary	Government	500
14. Sacred Heart Hospital of Malolos	Secondary	Private	99

(*Continued*)

Table 1. (Continued)

Hospital Name	Level	Type	Bed Capacity
15. St. Paul Hospital–Tuguegarao	Tertiary	Private	250
16. The Medical City Clark	Tertiary	Private	100
17. The Medical City Pangasinan	Tertiary	Private	70
18. The Medical City South Luzon	Tertiary	Private	150
19. Universidad de Sta. Isabel Health Services Department	**Tertiary**	**Private**	**150**
VISAYAS (n = 8)			
1. AMOSUP-Seamen's Hospital Iloilo	**Secondary**	**Private**	**43**
2. Antique Medical Center	**Secondary**	**Private**	**152**
3. Iloilo Doctors' Hospital	Tertiary	Private	300
4. Metro Iloilo Hospital and Medical Center	**Secondary**	**Private**	**110**
5. St. Paul's Hospital of Iloilo	Tertiary	Private	220
6. The Medical City Iloilo	Tertiary	Private	108
7. Western Visayas Medical Center	**Tertiary**	**Government**	**400**
8. Vicente Sotto Medical Center	**Tertiary**	**Government**	**1,200**
MINDANAO (n = 8)			
1. Ciudad Medical de Zamboanga	**Tertiary**	**Private**	**160**
2. Cotabato Regional Medical Center	**Tertiary**	**Government**	**600**
3. Davao Doctors Hospital	Tertiary	Private	250
4. General Santos Doctors Hospital	Tertiary	Private	202
5. Metro Davao Medical Research Center	**Tertiary**	**Private**	**129**
6. Northern Mindanao Medical Center	Tertiary	Government	400
7. Zamboanga City Medical Center	**Tertiary**	**Government**	**250**
8. Zamboanga Del Sur Medical Center	Secondary	Government	250
TOTAL (N = 44)			

* rows in blue: new in 2022

* rows in bold text: no data shared in 2022

https://doi.org/10.1371/journal.pdig.0000328.t001

One of the biggest contributing hospital members is the Philippine General Hospital, the National University Hospital, and the national government referral center, which serves more than 600,000 patients from all over the country every year [13]. Ten of the DOH designated cancer care centers (DCCC) are also members of the CARE PH HBCR system including National Kidney and Transplant Institute, East Avenue Medical Center, Bicol Medical Center, Vicente Soto Memorial Medical Center, Western Visayas Medical Center, Batangas Medical Center, Bicol Regional Teaching and Training Hospital, Zamboanga City Medical Center, Northern Mindanao Medical Center and Cotabato Regional and Medical Center [14].

All member hospitals have the following services: pathology, clinical laboratory, diagnostic imaging, hematology, oncology, surgical oncology, chemotherapy, but not all might have radiotherapy. It is notable that only four of the 44 hospitals have a functioning EMR, and most still rely on paper-based charts separate from laboratory information systems (LIS). The CARE PH HBCR System started functioning in July 2017 and its database includes patients with diagnosed cancer from January 13, 2017.

Case definition

All patients of any age and sex, seen in any hospital part of the CARE PH System or in hospital-affiliated oncology clinics, who have a clear basis for the diagnosis of cancer are included in the registry. Cancer patients undergoing any treatment modality, including palliative care, for the said disease are also included. The main basis for diagnosis is the pathology report of the diagnostic biopsy. In cancers like germ cell tumors where clinical diagnosis using biomarkers, or hepatocellular cancer where imaging of the liver of patients with risk factors like hepatitis B or C, surgical pathology or cytology reports are not needed for diagnosis of cancer and the patient is still entered into the cancer registry.

Staffing and training

Comprising a Tumor Registry Office in each CARE PH hospital is at least one Doctor Champion, and at least one Tumor Registrar, who are full-time employees of the hospital voluntarily contributing to the local cancer database. The Doctor Champion is an oncologist or general physician who consults regarding the important dates in the patient's cancer journey and helps the tumor registrar in deciding when the patient was diagnosed, relapsed, progressed, etc., as well as how to categorize the patient's malignancy. The Tumor Registrar, any hospital staff with a background in healthcare chosen by the Doctor Champion, is trained in Good Clinical Practice and data entry into the cancer registry app and also makes rounds to the different catchment areas within the hospital to collect information and regularly shares the hospital cancer registry data with the central database. Newly onboarded hospitals in the CARE PH HBCR System undergo a one-day training conducted by CARE PH Registry staff, introducing the application to both the Doctor Champion and Tumor Registrar, and are given a training manual which includes step-by-step instructions for encoding and data collection.

Data sources

The cancer patient journey typically begins with the diagnosis of cancer based on a biopsy report generated in a hospital's Pathology department. It is worth noting that in the Philippines, patients often receive care in more than one hospital during their cancer journey. Once a cancer diagnosis is confirmed, comprehensive staging procedures, such as radiological imaging and serum biomarker assessments, are conducted to evaluate the extent of the disease and predict its progression. Following this, the diagnosis is typically communicated by an attending oncologist who discusses treatment options, which are made after reaching consensus in a collaborative consultation involving a multidisciplinary healthcare team or hospital tumor board. Evidence-based surgical, radiation, or pharmaceutical interventions are then initiated and continued in a strategic manner with cure, extension of life, or quality of life as outcomes of interest.

Given this overview, catchment areas were identified within each member hospital, including: (1) Records Section, (2) the Pathology Department, (3) Specialty Out-Patient Clinics for cancers such as Germ-Cell Tumors, Liver Cancers, and Brain Cancers which do not need tissue biopsies for clinicians to diagnose and treat as cancer, and (4) Radiation and Chemotherapy Clinics for patients diagnosed in a different hospital, but sought treatment at a CARE PH hospital.

Data collection

The hospital tumor registrar goes to all the catchment areas, gathers the patients' identification numbers, and manually enters information into the hospital cancer registry on a regular basis. The data fields are distributed into the following modules: Hospital Information, Patient Data, Cancer Data, Cancer Treatment Intervention, and Patient Current Status Data. The data fields collect both standardized data through pre-selected drop-down options (i.e. primary site, diagnostic coding, staging, status) and free text data, where appropriate (i.e. CARE PH registry

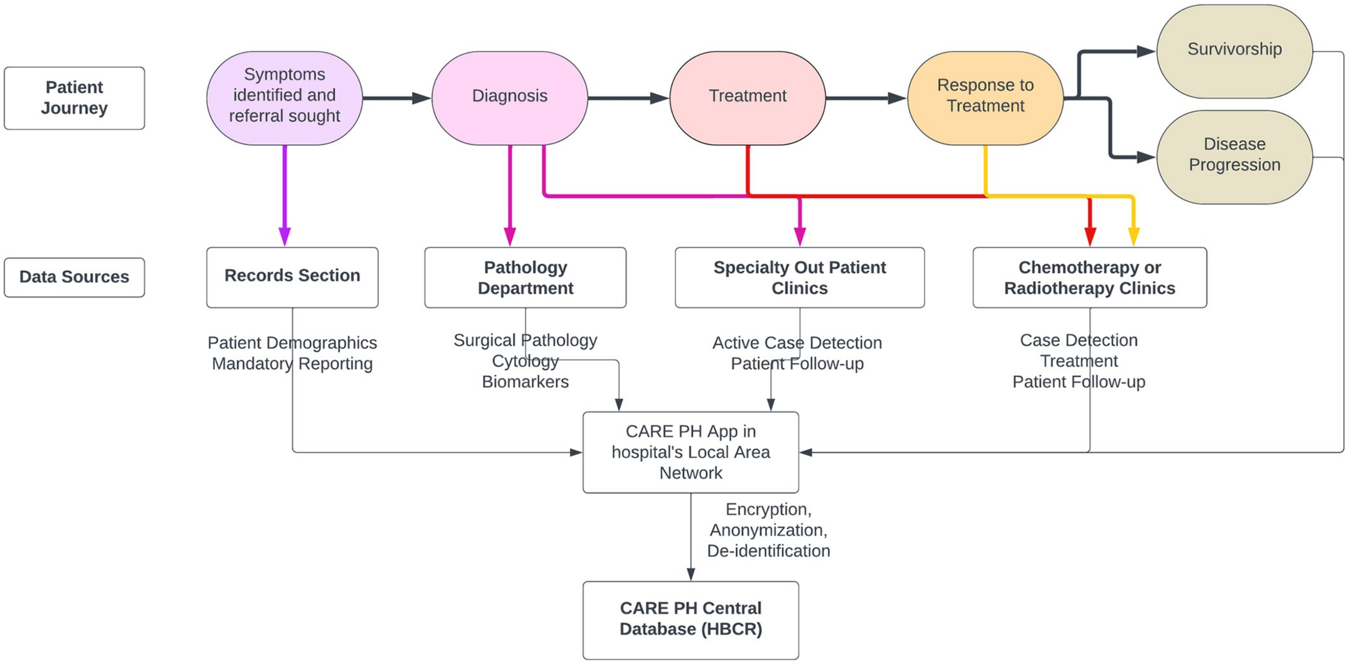

Fig 1. CARE PH Hospital Cancer Registry Catchment areas and data flow.

https://doi.org/10.1371/journal.pdig.0000328.g001

number, Patient Identification Number (PIN), imaging or pathology reports). Cancer diagnostic coding is done according to the International Classification of Diseases for Oncology, third edition (ICD-O-3) [15], and the staging is done using the American Joint Committee on Cancer, eighth edition (AJCC 8th) [16].

Only the tumor registrar and select hospital staff who have been properly trained on data entry, handling and security are given usernames and passwords to access the database.

Fig 1 illustrates the flow of data, mapping the cancer patient's journey to the entry points of data gathering from the catchment areas to the CARE PH web application, then on to the central CARE PH database. Once member hospitals have completed data collection from their respective sites, data is uploaded to CARE PH central servers on a weekly or monthly basis. The data entered and stored in the local area network includes patient identifiers, but the data shared with the central CARE PH database is encrypted, anonymized and de-identified, where patients are referred to only with a CARE PH registry ID bearing patient initials and birthdate. Registrants in the central database with the same initials, birthdate and primary site but entered into the database by different CARE PH hospitals are red-flagged by the central CARE PH app. These two entries are assumed to be the same patient who transferred from one CARE PH hospital to another, and the number of such entries are presented in the annual report.

After enrollment to the registry, the patient status is checked by the doctor champion and tumor registrar every 6 months or less, if there is any noted status change such as remission, recurrence, relapse or death. Data regarding follow-up status is recorded in the follow-up status and clinical outcome module.

Quality control and maintenance

There is no standard method for quality control of information for the HBCR. Practices per hospital may vary, with the doctor champion reviewing the information recorded, verifying consistency of data and checking for possible errors in encoding and tumor identification and classification. At the central database level, the CARE PH team works on performing checks to ensure collection of authentic and valid data, as well as checking for possible duplicates.

Regular backups of data are done to ensure no data loss. Backed up data is downloaded and stored in a separate local server and storage device.

Yearly review and reporting

The yearly report includes a consolidated cancer census that looks at the total number of new registrants, top primary sites for the entire HBCR system and a breakdown per hospital. Age distributions per primary site and top 10 primary sites per age group are also analyzed.

Analysis

The study primarily employed a descriptive statistical analysis approach, utilizing a dataset spanning six years from 2017 to 2022. An interactive graphing library called Plotly for Python was employed to create graphical representations of various analyses. To facilitate coding and script development, Visual Studio Code, run using Anaconda Navigator, was chosen, ensuring an efficient workflow throughout the process.

To ensure data integrity, an assessment of data fields with missing values was performed. This process contributed to refining the dataset by systematically removing fields exhibiting more than 90% missing values, ensuring that only informative variables were retained for subsequent analysis. Possible replications, for patients who were entered multiple times by different CARE PH hospitals, were removed by matching the automatically assigned registry number containing patient initials and date of birth, with cancer primary site. Following this preprocessing, an overview of cancer registrants in the database was presented, including their distribution across various hospitals and the frequency distributions of primary cancer sites recorded in the CARE PH census. It also explored the ten most common primary cancer types across ten CARE PH-HBCR sites to understand prevailing incidence trends. Additionally, the study examined the age distribution of patients with these top ten primary cancer sites based on data from the CARE PH registry. To offer a broader context, it investigated the regional distribution of cancer registrants, aiming to uncover potential geographic disparities. Furthermore, the analysis included a review of the frequency distribution of staging information across all primary cancer sites to assess the extent of cancer progression at the time of diagnosis.

Results

The data that support the findings of this study are openly available in figshare at http://doi.org/10.6084/m9.figshare.23665113.

Data fields in the CARE PH application

The CARE PH application comprises five sections, i.e., Hospital Information, Patient Data, Cancer Data, Cancer Treatment Intervention, and Patient Current Status Data, where each data field is identified by a unique code as detailed in Table 2. Among the 30 data fields, 17 exhibit 0–20% missing data (highlighted in green), eight displayed 21%-90% missing data (highlighted in yellow), while five depicted 91%-100% missing data (highlighted in red).

Data fields showing missing data within the 21–90% range were observed in the Patient Data section ("City"), the Cancer Data section ("Incidence Date," "Pathology Report Number," and "Stage"), and the entirety of the Patient Current Status section. The data field “City” holds no relevance for data analysis as data is analyzed by region and not city of residence; consequently, this particular field will be removed from the application in future updates. Within

Table 2. Breakdown of null values in the data fields of CARE PH registry.

Entry	Null Count	Total Count	Null Percentage
HOSPITAL INFORMATION			
Date Created	2	60021	0.0033%
Institution ID (Internal ID assigned to the Institution or Hospital)	75	60021	0.12%
Institution Name (Name of the Institution or Hospital)	75	60021	0.12%
Copy of Institution ID	0	60021	0
PATIENT DATA			
ID (Record ID in the database table)	0	60021	0
Hospital Patient ID	0	60021	0
Registration ID (Assigned to the Patient in the Institution or Hospital)	0	60021	0
Birthdate	9861	60021	16.43%
Sex	80	60021	0.13%
City	34149	60021	56.90%
Provincial Code (Assigned to the province of the patient)	1230	60021	2.05%
Patient Date Created (Date when the patient data was first encoded)	0	60021	0
CANCER DATA			
Primary Site	0	60021	0
Primary Site ICD 10 ID (ID assigned to a Primary Site)	0	60021	0
ICD 10 ID (ID assigned to a ICD10)	1608	60021	2.68%
Health Facility Entry Date (Date when the Patient was first admitted in the Institution or Hospital)	0	60021	0
Incidence Date	13823	60021	23.03%
Pathology Report No	18389	60021	30.64%
Stage	44717	60021	74.50%
Patient Primary Site Date Created (Date when the Primary Site data was first encoded)	0	60021	0
CANCER TREATMENT INTERVENTION			
Cancer Surgery Date	60021	60021	100%
Radiation Treatment Start Date	60021	60021	100%
Systemic Treatment Start Date	60021	60021	100%
Palliative Treatment Start Date	60021	60021	100%
PATIENT CURRENT STATUS DATA			
Patient Primary Site Date Updated (Date when the Primary Site data was last updated)	0	60021	0.0
Primary Site Change in Status Stage	55711	60021	92.82%
Patient Primary Site Status Date Created (Date when the status of the primary site was first encoded)	48726	60021	81.18%
Patient Primary Site Status Date Updated (Date when the status of the primary site was last updated)	48727	60021	81.18%
Patient Primary Site Status Date (Date of the Primary Site Change in Status)	48737	60021	81.20%
Patient Primary Site Status Change (Primary Site Change in Status (incidence, no change, remission, stable disease, etc.))	49034	60021	81.69%

* rows in green: 0%-20% missing data

* rows in yellow: 21%-90% missing data

* rows in red: 91%-100% missing data

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the data fields highlighted in yellow, namely "Incidence Date", "Pathology Report Number" and "Stage", the presence of missing data can be attributed to those patients who have undergone diagnostic biopsies and staging procedures done in healthcare facilities outside the CARE PH hospital from where they are receiving cancer treatment. While these external pathology reports, staging laboratory, and radiologic images may be in their oncologists' clinic charts, these remain inaccessible to the hospital tumor registrar.

Meanwhile, data fields exhibiting over 90% missing data were found exclusively within the Cancer Treatment Intervention section and in the "Primary Site Change in Status Stage" data field of the Patient Current Status section. This missing data, evident in the red-highlighted rows of the Cancer Treatment Intervention section, underscores the inherent challenge of accessing the clinical notes maintained by the treating physicians.

Hospital membership

Out of the 44 hospital institutions that signed a Memorandum of Agreement with CARE PH, 27 CARE PH-affiliated hospitals actively contributed their data to the central CARE PH database, while 17 CARE PH hospitals did not participate in data sharing. Their lack of participation can be attributed to several reasons, including one of the following: (1) the inclusion of new members who were not yet prepared to share their data [17], (2) temporary halts in data collection by some hospitals due to force majeure or pandemic-related challenges, resulting to difficulties in resuming [17], and (3) a subset of hospitals opting to input their data into the non-communicable diseases registry of the Department of Health (DOH) instead of the CARE PH database.

In the period spanning from 2017 to 2022, a total of 60,021 cancer registrants were entered into the CARE PH central database, with the Philippine General Hospital having the highest number of registrants, and National Kidney & Transplant Institute having the second highest number of cancer registrants across all partner hospitals, as seen in Table 3. NCR harbors a higher proportion of partner hospitals compared to other regions, potentially suggesting a possibility of expanding hospital partnerships beyond the current hospital institutions.

Table 3. CARE PH hospitals with the number of registrants in database.

Region	Institution (year joined)	Number of Registrants
NCR	1. Philippine General Hospital	12,040
	2. National Kidney & Transplant Institute	11,244
	3. The Medical City Ortigas	9,845
	4. Makati Medical Center	3,940
	5. Medical Center Manila	2,862
	6. Chinese General Hospital	2,762
	7. East Avenue Medical Center	2,290
Region I	1. Dagupan Doctors Villaflor Memorial Hospital	5,646
	2. The Medical City Pangasinan	69
CAR	1. Baguio Medical Center	131
Region II	1. St. Paul Hospital of Tuguegarao	133
Region III	1. The Medical City Clark	237
	2. Bulacan Sacred Heart	179
Region IV-A	1. Batangas Medical Center	1,412
	2. Rizal Medical Center	935
	3. Global Cancer Care Institute	14
Region IV-B	1. Palawan MMG-PPC	3

(*Continued*)

Table 3. (Continued)

Region	Institution (year joined)	Number of Registrants
Region V	1. Bicol Medical Center	2,474
Region VI	1. The Medical City Iloilo	283
	2. Iloilo Doctors Hospital	239
Region IX	1. Zamboanga Del Sur Medical Center	13
	2. Zamboanga City Medical Center	5
Region X	1. Northern Mindanao Medical Center	1,161
Region XI	1. Davao Doctors Hospital	736
	2. Metro Davao Medical and Research Center	57
Region XII	1. Cotabato Regional & Medical Center	1,207
	2. General Santos Doctors Hospital	29
Missing Values		75
	TOTAL	60,021

https://doi.org/10.1371/journal.pdig.0000328.t003

Cancers diagnosed and/or treated in hospitals

The number of diagnosed cancer cases over the years encompasses a range of 28 possible primary sites with corresponding ICD-10 categories in the CARE PH app. The progressive increase in the number of newly diagnosed cancer cases as depicted in Fig 2, can be related to the increase in the number of hospitals transmitting data. Among the 60,021 cancer patients with recorded primary sites in the central CARE PH database from 2017–2022, breast cancer was the most common primary site, accounting for 17,660 cases, or 29.4% of all cancer registrants (Fig 3). This was followed by colorectal cancer at 11.1%, cervical cancer at 6.2%, head and neck cancer at 5.9%, prostate and other male genital cancer at 5.1%, uterine cancer at 4.9%, thyroid cancer at 4.6%, blood dyscrasia at 4.5%, lung cancer at 4.2%, and lymph node cancer at 3.0%. There were 12,647 patients with cancers from less common primary sites. Fig 4 shows the breakdown of these other cancers.

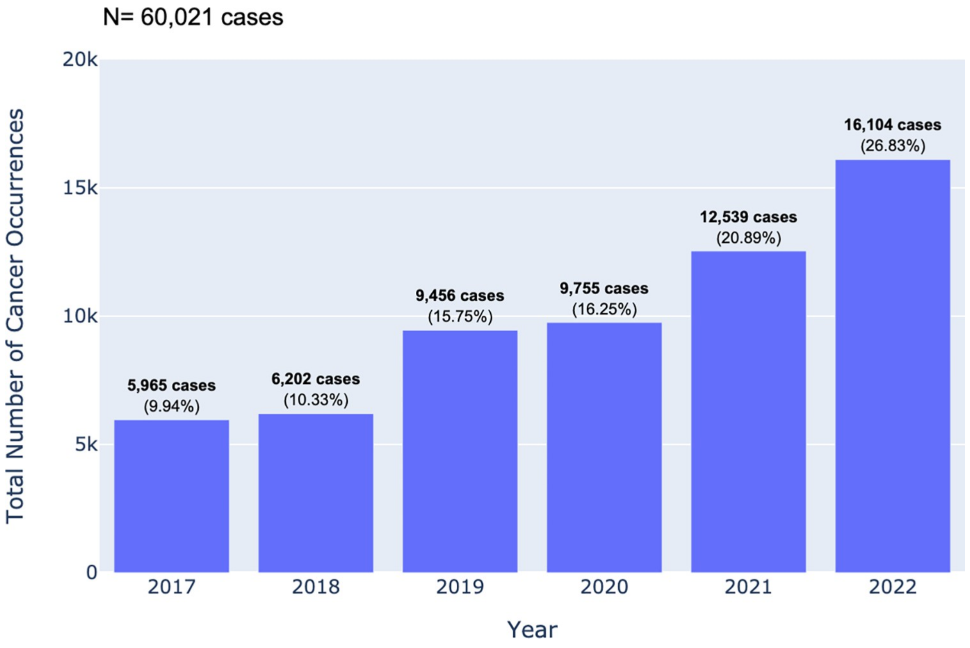

Fig 2. Frequency of primary cancer sites in CARE PH cancer census from 2017 to 2022.

https://doi.org/10.1371/journal.pdig.0000328.g002

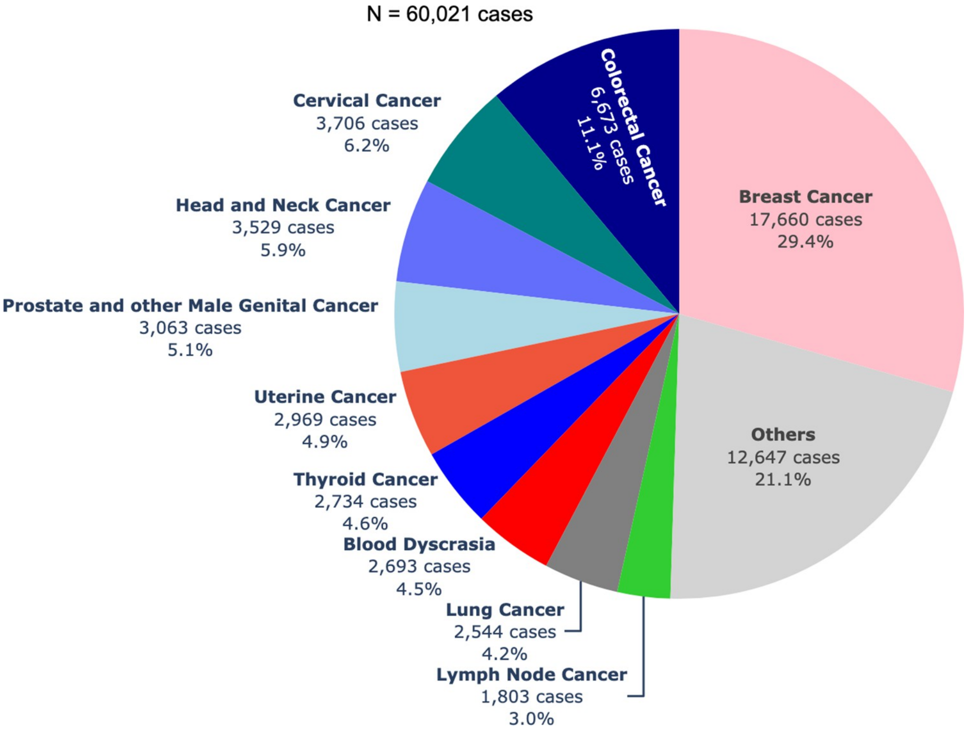

Fig 3. Frequency of top ten primary cancer sites in CARE PH Cancer Census from 2017 to 2022.

https://doi.org/10.1371/journal.pdig.0000328.g003

On another note, Table 4 demonstrates the frequency distribution for the most prevalent primary cancer cases diagnosed at the top 10 CARE PH-HBCR sites, offering insights into regional disparities in cancer diagnosis and healthcare accessibility. A significant concentration of cancer diagnoses occurred within NCR, home to some of the Philippines' leading healthcare institutions. The roles of these prominent hospitals are pivotal in cancer diagnosis, reflecting both the high population density in the NCR and the advanced medical infrastructure these institutions offer. Beyond NCR, several hospitals outside this region also emerged as frequent sites for cancer diagnosis. Notably, Dagupan Doctors Villaflor Memorial Hospital, Bicol Medical Center, and Batangas Medical Center have made their mark as key players in addressing the cancer burden in their respective areas. This highlights the crucial role of regional healthcare centers in providing essential cancer diagnosis and treatment services to communities beyond the NCR.

Table 5 presents a breakdown of the age distribution of the top ten primary cancer sites, where the ages were retrieved by referencing the date of initial diagnosis of the primary sites. The cells highlighted in yellow indicate the age range with the highest number of registrants. Breast cancer, head and neck cancer, uterine cancer, and thyroid cancer were the most frequently diagnosed types of cancer among individuals aged 50–59 years, while colorectal cancer, prostate and other male genital cancer, blood dyscrasia, lung cancer, and lymph node cancer were more commonly diagnosed in individuals aged 60–69 years. Cervical cancer was most frequently diagnosed in individuals aged 40–49 years. These insights denote the significance of age-specific cancer screening to address the varying prevalence of cancer types across different age groups, ultimately contributing to improved healthcare outcomes and early interventions.

Out of the total population, 1339 (2.2%) belong to the pediatric population (aged 0–19). The most frequently diagnosed cancers under this group are blood dyscrasias, with 357 cases

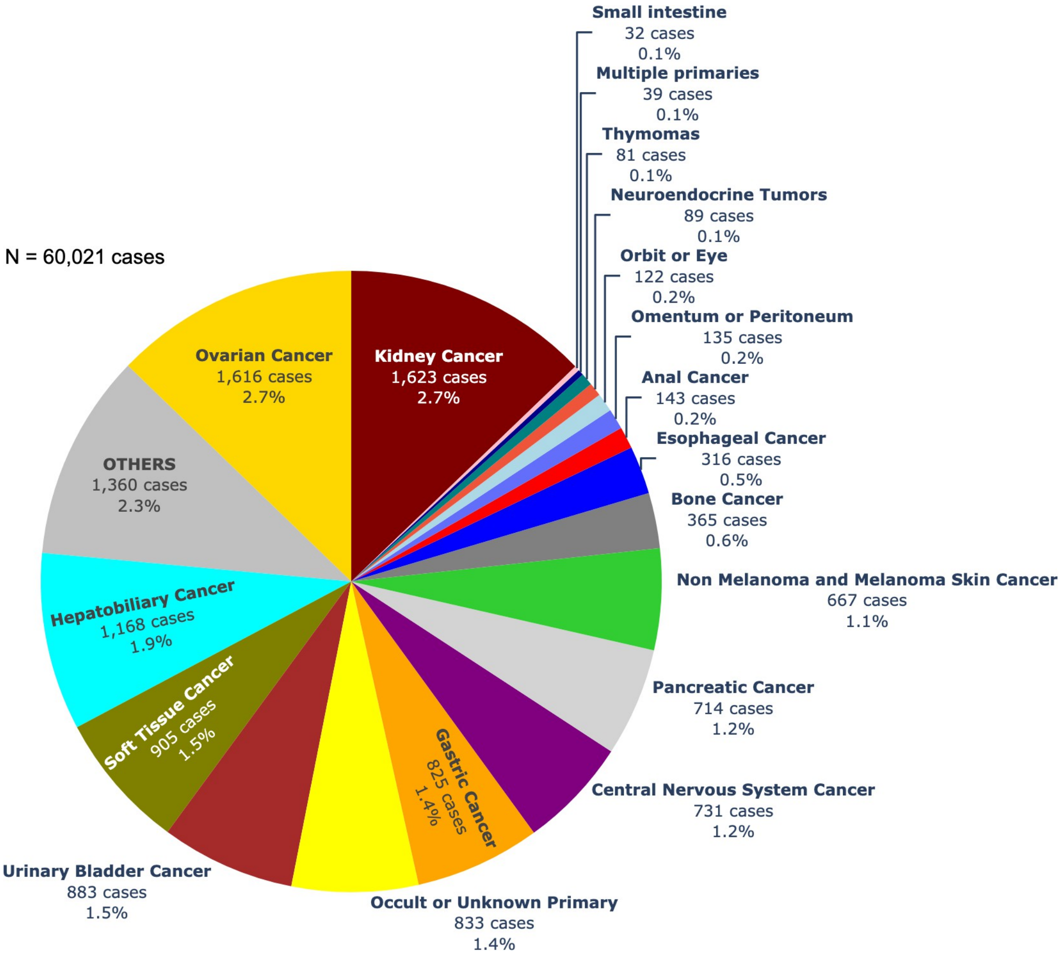

Fig 4. Frequency of 11th-28th ranking primary cancer sites in CARE PH Cancer Census from 2017 to 2022.

https://doi.org/10.1371/journal.pdig.0000328.g004

or 26.7% of the population, followed by lymph node cancer at 9.6%, breast cancer at 7.6%, head and neck cancer at 5.8%, and colorectal cancer at 4.0%. Four hundred ninety-six fall under the "Others" primary site, which is a basket category of primary sites which cannot be classified under the other categories, including carcinoma-in-situ, melanoma-in-situ, and neoplasms of uncertain and unspecified behavior.

In 2017, only three hospitals were actively sharing their data for the CARE PH hospital cancer registry. Specifically, two of these hospitals were located in the National Capital Region (NKTI and The Medical City Ortigas), while the third was situated in Region I (Dagupan Doctors Villaflor Memorial Hospital). Over the subsequent years, there has been a steady increase in the number of participating hospitals, reflected in the progressive increase of yearly registrants, with representation expanding to encompass various regions. Remarkably, the National Capital Region consistently exhibited the highest annual contribution of cancer patient data (as illustrated in Fig 5). As of the year 2022, hospitals from Regions I, II, III, IV-A, IV-B, V, VI, IX, X, XI, XII, Cordillera Administrative Region (CAR), and NCR actively contribute to the CARE PH hospital cancer registry. In contrast, Regions VII (Central Visayas), VIII (Eastern Visayas), and Autonomous Region of Muslim Mindanao (ARMM) have yet to establish their presence within the CARE PH HBCR system. This could be because Region VII, Cebu maintains its own population-based cancer registry, directly transmitting cancer data to the

Table 4. Frequency distribution of top ten primary cancers at ten CARE PH-HBCR sites.

	Breast Cancer	*Colorectal Cancer*	*Cervical Cancer*	*Head and Neck Cancer*	*Prostate and other Male Genital Cancer*	*Uterine Cancer*	*Thyroid Cancer*	*Blood Dyscrasia*	*Lung Cancer*	*Lymph Node Cancer*	*Other Primary Sites*	*TOTAL*
Philippine General Hospital	2359	1316	970	710	326	1008	733	517	386	382	3333	12040
National Kidney & Transplant Institute	2382	1019	283	284	1246	172	112	1566	384	534	3262	11244
The Medical City Ortigas	3205	989	730	568	520	598	668	267	540	178	1582	9845
Dagupan Doctors Villaflor Memorial Hospital	1908	604	622	634	116	254	278	24	332	104	770	5646
Makati Medical Center	1399	373	147	164	173	205	250	105	287	131	706	3940
Medical Center Manila	1052	366	139	193	90	123	207	27	153	51	461	2862
Chinese General Hospital	765	413	128	128	282	171	220	3	66	18	568	2762
Bicol Medical Center	763	254	333	211	81	179	39	62	77	47	428	2474
East Avenue Medical Center	844	436	57	297	55	45	55	3	42	79	377	2290
Batangas Medical Center	556	223	120	74	18	74	25	38	35	30	219	1412
Other hospital institutions	2387	678	177	266	156	139	146	80	241	249	912	5431
Null Count	40	2	0	0	0	1	1	1	1	0	29	75
TOTAL	17660	6673	3706	3529	3063	2969	2734	2693	2544	1803	12647	60021

https://doi.org/10.1371/journal.pdig.0000328.t004

Table 5. Age distribution of top 10 primary cancer sites from CARE PH registry.

PRIMARY CANCER SITE	**AGE DISTRIBUTION**								**Missing values**	**TOTAL**
	0–19	**20–29**	**30–39**	**40–49**	**50–59**	**60–69**	**70–79**	**Over 80**		
Breast Cancer	102	171	1376	3735	4397	3166	1209	287	3217	17660
Colorectal Cancer	54	98	329	695	1445	1902	925	235	990	6673
Cervical Cancer	29	96	567	868	768	480	143	25	730	3706
Head and Neck Cancer	78	150	302	561	751	723	309	87	568	3529
Prostate and other Male Genital Cancer	16	76	38	68	297	993	833	222	520	3063
Uterine Cancer	10	40	228	441	792	616	221	23	598	2969
Thyroid Cancer	50	230	346	374	489	404	135	38	668	2734
Blood Dyscrasia	357	274	249	314	405	497	264	66	267	2693
Lung Cancer	18	24	60	192	394	727	466	122	541	2544
Lymph Node Cancer	129	310	243	174	241	324	160	43	179	1803
Others	496	541	894	1629	2683	2892	1532	397	1583	12647
TOTAL	1339	2010	4632	9051	12662	12724	6197	1545	9861	60021

Legend

Yellow highlighted cells indicate the age range with the highest number of registrants

https://doi.org/10.1371/journal.pdig.0000328.t005

Fig 5. Regional distribution of cancer registrants 2017–2022.

https://doi.org/10.1371/journal.pdig.0000328.g005

Department of Health. Moreover, Region VIII experienced significant challenges following the impact of typhoon Yolanda in November 2013, leading to the departure of specialist oncologists who have not returned to the region. Additionally, ARMM, situated in the southern part of the archipelago, faces irregular and challenging internet connectivity, thereby contributing to the missing data.

The increasing participation of hospitals in the CARE PH hospital cancer registry, from three in 2017 to multiple regions by 2022, underscores a growing commitment to comprehensive cancer data collection and highlights the need for further expansion to ensure a more holistic understanding of cancer prevalence nationwide.

Baseline cancer staging

Fig 6 showed that 49,730 or 83% of all 60,021 patients in the database had missing data in the "stage of baseline cancer" data field. Cancer stage is considered essential in the diagnosis of any cancer as it provides information regarding tumor burden and is a prognostic indicator for the disease. The cancer staging system that is most commonly used globally is the TNM Classification system where T refers to tumor size, N refers to regional lymph node involvement and M refers to presence or absence of metastases. In Fig 6, the missing values bar encompasses primary cancer sites including blood cancers, germ cell tumors, and brain tumors, which are not amenable to TNM classification, and it also accounts for entries where staging information remains unknown to the data encoder.

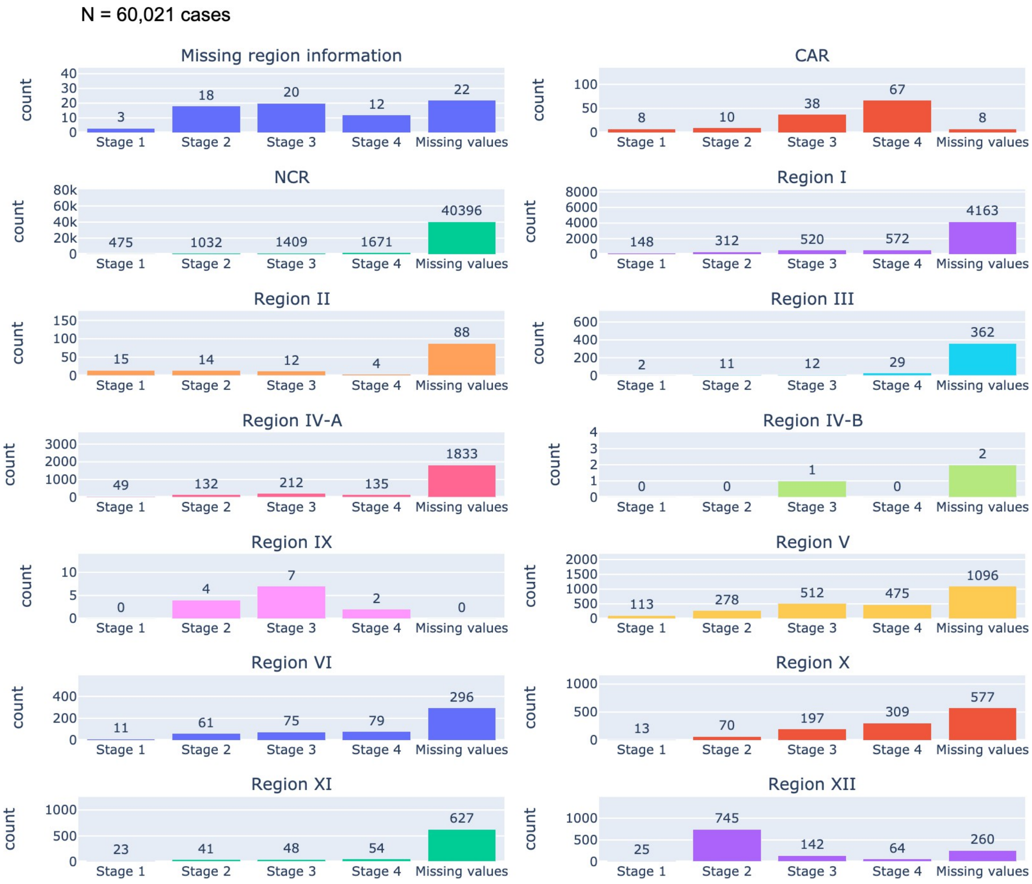

Fig 6. Frequency distribution of staging information from all primary cancer sites in CARE PH Cancer Census from 2017 to 2022.

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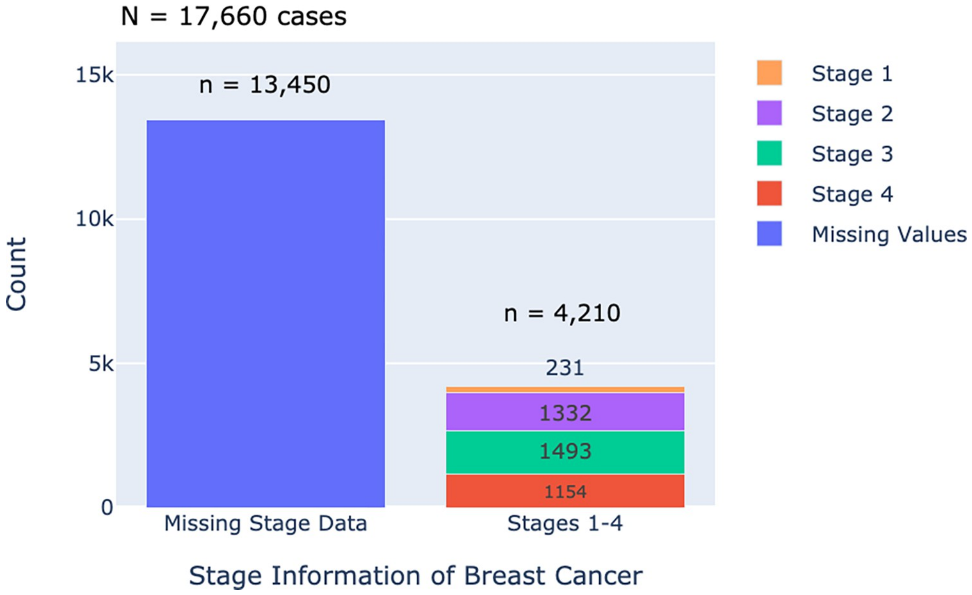

Fig 7. Stage information of breast cancer.

https://doi.org/10.1371/journal.pdig.0000328.g007

Distribution of cancer staging varies across regions, yet uniformly, all regions exhibited a higher prevalence of cancers in stage 3 or 4 in comparison to stages 1 and 2 upon initial entry into the hospital cancer registry. A noticeable scarcity of stage 1 diagnoses is seen, a phenomenon that ideally should be more pronounced with the effective implementation of cancer screening programs. A similar trend is seen when examining the most prevalent cancer type within the 2017 to 2022 CARE PH census. As depicted in Fig 7, breast cancer in the Philippines is most often diagnosed in Stage 3, followed by Stage 2, Stage 4, then stage 1.

Discussion

This paper presents an exploratory data analysis conducted on a cohort of 60,021 cancer patients who have been enrolled in the central database of the CARE PH-HBCR from 2017 to 2022. CARE PH-HBCR constitutes a collaborative network encompassing 44 hospitals within the Philippines, comprising 15 publicly funded institutions and 29 privately operated hospitals. Out of the 44 hospital institutions, 27 hospitals actively and regularly contributed de-identified patient data at regular intervals, typically on a monthly to quarterly basis, through the utilization of the sole web-based HCBR system currently available in the country.

Cancer incidence

In light of the Global Cancer Observatory's 2020 population-based cancer registry data, the estimated annual incidence of cancer in the Philippines stands at 153,751 cases [18]. In contrast, the CARE PH HBCR network recorded 16,708 diagnosed and/or treated cancer patients in 2022. While this figure is not fully representative of cancer incidence or newly diagnosed cases, as per the PBCR definition, it does represent a little over 10% of the annual estimated incidence of newly diagnosed cancer cases.

When examining the epidemiology of cancer in the country, the regional data presented in the database needs to be interpreted with caution. Not all regions are adequately represented, and the regions that are included have varying starting dates of data collection. For instance, analysis of the data presented in Table 3 highlights that NCR harbors the highest proportion of partner hospitals when compared against other regions. This disparity in hospital distribution potentially results in a situation where the reported cancer cases may not sufficiently reflect the entirety of the country's various regions. Furthermore, as depicted in Fig 2, some have been collecting data since as early as 2017, while others may have only started entering data in the latter half of 2022. As a result, the overall analysis may be constrained in terms of its completeness and accuracy.

While there are caveats in observing the regional data, the general trend of cancer cases from 2017 to 2022 reveals a consistent increase in the number of member hospitals and consequently, in the number of patients with cancer registered. However, an observable plateau in these figures became evident in 2020, coinciding with the onset of the COVID-19 pandemic. As seen in Fig 2, the pandemic-induced disruption had a notable impact on the diagnosis and treatment of cancer in the Philippines, resulting in a significant deficit in expected numbers of people with cancer to undergo diagnostic and therapeutic modalities in hospitals. In 2021, a resurgence in the number of hospitals occurred, and the count of cancer patients accessing these healthcare facilities eventually caught up with the preceding upward slope of trajectory. It is worth postulating that there were relatively more Stage 2 and 4 patients diagnosed and/or treated in CARE PH hospitals in 2021, relative to that number in 2019.

A study conducted in the United Kingdom revealed significant increases in avoidable cancer-related deaths in England, attributable to diagnostic delays resulting from the impact of the COVID-19 pandemic [19]. Following the implementation of a national lockdown in 2020 in response to the pandemic, several measures were enacted, including the suspension of cancer screening, deferral of routine diagnostic procedures, and prioritization of urgent symptomatic cases, similar to the occurrences in Spain [20], Canada [21], Brazil [22], the United States [23], and the Netherlands [24]. These findings collectively suggest that the observed trends in 2020, aligning with the COVID-19 pandemic, could be linked to the disruptions caused by the pandemic across healthcare systems globally.

Regardless, the rising number of cancer registrants in the past six years reflects an increasing trend of partner hospital institutions sharing their data in the CARE PH central database. Such a development indicates the registry's growing comprehensiveness and accuracy, providing a foundation for a more detailed understanding of cancer burden in the Philippines–a necessary step in developing effective cancer control strategies and programs, for better health outcomes.

Baseline cancer staging

In 2020, a significant shift occurred as breast cancer, by a narrow margin, surpassed lung cancer in terms of incidence, according to data from the Global Cancer Observatory's population-based cancer registry [11]. In the Philippines, specifically within the population-based cancer registries of Rizal Province, Metro Manila, and Cebu, breast cancer has always far outnumbered the incidence of lung cancer in incidence as depicted in Fig 3. This phenomenon is not unique to the Philippines; across much of Asia, breast cancer has held its position as the most frequently diagnosed cancer for many years [25–27].

Focusing on breast cancer staging data, we gain deeper insights into this prevailing health concern. As depicted in Fig 7, we find that 13,450 out of 17,660 patients, representing 76% of cases, lack essential staging data. From the 24% of patients with staging information, it can be observed that in the Philippines, breast cancer diagnoses are predominantly made at advanced stages, with Stage 3 cases constituting the highest proportion at 35.5%, followed closely by

Stage 2 at 37%, and Stage 4 at 27.5%. In contrast, Stage 1 breast cancer is notably less common, indicating a pressing need for increased efforts in early detection and awareness campaigns to identify cases at earlier, more treatable stages.

In demonstrating the significance of executing screening programs to reduce incidence of advanced-stage breast cancers, in countries like Lebanon, the implementation of screening programs has yielded notable results, with approximately 31% of breast cancer patients being diagnosed at stage 1, 47% at stage 2, 14% at stage 3, and 8% with distant (metastatic) stage 4 disease [28]. In the Münster district of northwestern Germany, carrying out an organized mammography screening program resulted in a significant decrease in the incidence rates of advanced breast cancer, while simultaneously leading to an increase in early-stage breast cancer incidence rates [29]. A study utilizing data from the the United States Surveillance, Epidemiology, and End Results Program reported that the incidence of advanced breast cancer would have been 29% higher in the absence of mammography screening [30]. The aforementioned studies serve as valuable baselines for assessing the effectiveness of breast cancer screening initiatives, with the goal of being able to diagnose more non-palpable breast masses in the earlier stages of cancer. Comparative data like these, which show the baseline stage of cancer gathered in the CARE PH database vis-à-vis databases from high-income-countries (HIC) like the United States, provides breast cancer screening programs in LMIC a good baseline upon which to assess the success of their cancer screening and early detection programs, with the goal being to diagnose more non-palpable breast masses in the earlier stages of cancer.

Limitations of the HBCR app

The database, despite being equipped with fields for recording the stage at the time of diagnosis, the administered treatments, and the subsequent status of the diagnosed patients, largely lacks information in these categories, as depicted in Table 2. Among the modules comprising the hospital cancer registry application, it is observed that the module containing patient demographics exhibits the lowest incidence of missing data, ranging from 0% to 20%. In contrast, the module dedicated to capturing baseline characteristics of primary cancer displays a relatively higher degree of missing data spanning from 21% to 50%. The module concerning patient status or outcome after initial baseline data input records the highest incidence of missing data, with values ranging from 91% to 100%. Table 2 presents that only 25% of the cancer stage fields within the central database are completed, and a minimal 2% of the cancer status or outcome data fields are filled up.

The notable prevalence of missing data in the cancer registry stems from the intricacies of its data input process. Information pertaining to cancer staging and treatment outcomes is not readily available within documents found in catchment areas such as pathology reports, chemotherapy logbooks and radiation oncology reports, but is contained in either paper charts or electronic medical records (EMR). Remarkably, only 4 of the 44 (9%) participating CARE PH hospitals have EMR systems, and, regrettably, even in such instances, there is the absence of an application program interface (API) for seamless integration between the hospital's EMR and the HBCR system. Although staging and treatment status can be determined by manual methods such as poring over paper records, cross-referencing with CT scan findings and laboratory reports via patient PIN numbers, or relying on physicians to enter staging data or patient status into the registry, these approaches prove inefficient, requiring additional manpower and funding. Moreover, it is to be noted that Doctor Champions and Tumor Registrars, who voluntarily engage in the HBCR system, may concurrently bear other responsibilities beyond data collection and encoding.

Proposed framework of the HBCR app

The Philippine Health Insurance Corporation or Philhealth is mandated by the Universal Healthcare Act of 2019 to establish the National Health Data Repository (PHIC-NHDR). While the systems architectural design of the PHIC-NHDR starts with each hospital in the country transmitting their EMRs centrally via application programming interface or APIs, less than 60% of all hospitals in the country have EMRs.

To address this issue, CAREPH has devised an interim solution: to find a way to include staging and treatment data, which is the purview of physicians and not data encoders, a mandatory requirement in the monthly radiation oncology reports and chemotherapy logbooks. Such a step is particularly relevant for hospitals lacking EMRs at present. For those CARE PH hospital members already equipped with EMRs, the subsequent challenge lies in developing APIs that facilitate the seamless transfer of data from EMR systems to the CARE PH application, or alternatively, from the hospital information system (HIS) to the CARE PH application. Once done, the existing gaps in staging, treatment, and patient outcomes data will effectively be bridged, rendering the CARE PH HCBR system's database will be more robust, informative, and useful.

More granular data collection particularly for common cancers like breast, lung, and colorectal cancer, i.e., identification of molecular or genomic biomarkers to be used as guide to treatment, can be included in future plans for HBCR, or for site-specific cancer registries. Once anonymized, such data no longer fall under the classification of human data and can be opened up for scientific research purposes. Researchers can then interrogate the data with relevant research questions, consequently leveraging big data analysis, machine learning, and artificial intelligence in moving forward towards better and more accessible cancer healthcare in the country.

Conclusion and recommendations

The creation of a nationwide system of hospital-based cancer registries has important implications for cancer management, especially in resource limited low and middle income countries. This is a fact recognized by healthcare providers, given the steady growth in the number of hospitals contributing to the CARE PH HBCR system from 2017 to 2022. The higher the volume of data points, the clearer and more accurate the picture of the cancer burden in the country. Such data can now be used as a baseline for epidemiologic research studies, or for the assessment of the success of future intervention programs that aim to decrease the incidence of cancer by the promotion of cancer screening and prevention in the communities; or create better outcomes for patients by streamlining treatment protocols.

The challenges identified in this analysis include lack of baseline staging and first-line treatment data, and lack of status changes and subsequent treatment of the disease over time. Digital transformation of hospitals from paper-based charts to EMRs and the integration of the HBCR to the EMR and hospital information system (HIS) will likely be the best solution for these limitations.

The main lesson learned by CARE PH in the past 6 years is that all the elements of a proper HBCR–data privacy, quality, integrity, interoperability, adaptability, flexibility to modern technology–embedded in a well designed enterprise architecture, functioning under the guidance of a dedicated and strong leadership and governance team, must be present in order to create and maintain a robust HBCR that is useful for furthering registry and research in the country.

The researchers recommend that the creation and maintenance of HBCRs nationwide must be harmonized, not siloed, and must be embedded in all relevant national programs and legislations.

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APPENDIX B 2023 PHILIPPINE DATATHON

1. Program Overview

The event took place at the Henry Sy, Sr. Hall, De La Salle University, Taft Avenue, Manila. The schedule for the first day was structured as follows:

Registration: Attendees were welcomed to register, facilitated by the Datathon staff. Prayer and National Anthem: Dr. Ruth Angelie Cruz led the reflective prayer and the national anthem to start the proceedings.

Dr. Raymond Francis Sarmiento gave an introduction, setting the stage for the day’s agenda.

Dr. Raymond Girard R. Tan gave a speech focusing on the event's importance and the collaborative spirit.

Welcome Remarks were given by NIH Executive Director, Dr Eva Maria Cutiongco-dela Paz.

PCHRD Executive Director Dr Jamie C. Montoya provided an important address that contributed to the thematic depth of the event.

Objective: Gather advocates of data governance and management and discuss opportunities and challenges for artificial intelligence in the health sector.

Methods: The event adopted various methods such as lectures, panels, workshops, and a competition. Participants were actively engaged to participate through open fora and collaborative activities. Slides were collected and summarized into their salient points using ChatGPT4. Authors validated the output.

Results: A network of advocates, composed of institutions and individuals, was formed. Recurring issues on data governance and management including ethics were identified and documented in these proceedings.

Conclusion: The Philippine Datathon 2023, the third in a series of activities after Big Data Philippines 2017 and 2018, demonstrated the importance of a community of advocates to stimulate and maintain interest in the ethical management of health data and its use for artificial intelligence. Continued discourse among the advocates is key to clarifying ambiguous concepts of artificial intelligence and in presenting its risks and benefits for advancing public health objectives and for fostering innovation.

2. Introduction

The growing importance of data science in public health is driven by its ability to analyze vast amounts of health data to identify trends, predict outbreaks, and improve healthcare delivery. By leveraging machine learning, artificial intelligence, and statistical tools, data science enables public health professionals to make data-driven decisions, enhancing the effectiveness of health interventions and policies for better population health outcomes.

Since 2011, the University of the Philippines Manila has hosted the MIT Critical Data team for a series of visits and lectures around health information management. In 2017, the first Big Data Philippines was held with co-organization with UP Cebu followed by another one co-hosted by

UP Diliman in 2018. For this third in a series, the new organizers, CARE PH and De La Salle University agreed to rename the event to Philippine Datathon 2023. The theme selected was *“How can artificial Intelligence contribute to universal health coverage?”* with the goal of threshing out ideas on the ability of new and emerging technologies in catalyzing healthcare in the country.

3. Methodology

This report contains observations of the authors as well as synthesis of slides and documents provided by resource speakers using ChatGPT4.

4. Results

Setting the context

Prof. Philip Zuñiga focused on the significance of HL7 fast Healthcare Interoperability Resources (FHIR) as a syntactic and semantic standard for health, highlighting its crucial role in data interoperability and efficient decision-making. He listed the challenges of using big data, particularly when the data is invalidated, untimely, and cannot be aggregated, rendering it ineffective for practical use. Prof. Zuñiga elaborated on the benefits of FHIR, including its use of APIs, implementable data model, open-source nature, and maximization of standard web technologies, underscoring its adaptability and efficiency in health data management.

Dr. Romulo de Castro emphasized the importance of preparing data for machine learning (ML) and artificial intelligence (AI) especially in health care. He emphasized the importance of interoperability, ethical use of data, and its governance. He outlined various projects and ongoing initiatives aimed at enhancing health data management and utilization, including efforts to improve data quality, security, and ethical considerations. His main message was the critical role of data governance in achieving effective health data interoperability, supporting patient care, and facilitating research and policy development.

Dr. Romulo de Castro and Dr. Beatrice Tiangco explored various facets of data science, emphasizing its application in health and health research. They delved into the definition of data science, highlighting its nature as both a science and a multidisciplinary field, and discussed its role in innovative health solutions, including drug discovery and aging research. They each related the state of data science from their perspectives and suggested directions for future development and the importance of collaborative research efforts.

Dr. Leo Celi's presentation on "UHC and the Bias in Health Data" discusses the impact of data bias on artificial intelligence in healthcare, highlighting how such biases in data collection and interpretation can lead to disparities in diagnosis and treatment recommendations. He emphasized the importance of recognizing and addressing these biases to ensure equitable and effective healthcare outcomes. Dr Celi advocated for relevant education, diversity of expertise, and continuous monitoring in the deployment of AI to mitigate these biases and improve health data's reliability and utility.

Dr. Fresthel Climacosa introduced REDCap (Research Electronic Data Capture) as a secure, web-based application designed for data collection and management in research studies, highlighting its development by Vanderbilt University in 2004. She discussed REDCap's global impact, with a vast network of collaborators and projects worldwide, and its specific application in various COVID-19 related studies. She enumerated REDCap's features, such as high data

quality, secured data sharing, timely analysis, and cost-effectiveness, making it a valuable tool for health research data management.

Workshops

In Workshop 1, Matthew McDermott explored the challenge of confounding AI models for medical imaging, particularly focusing on pneumothorax detection. He discussed the importance of identifying and addressing hidden stratifications and shortcut features that could lead to biased or inaccurate model predictions. The session emphasized the value of collaboration in small groups to examine these issues, and in using tools like saliency maps for error auditing and improving model validation.

Workshop 2 with Matthew McDermott discussed the challenge of AI models for medical imaging, particularly focusing on pneumothorax detection. The group detailed the importance of identifying and addressing hidden stratifications and shortcut features that could lead to biased or inaccurate model predictions.

The workshop on "Introduction to Causal Inference" provided foundational knowledge on distinguishing between causation and correlation, emphasizing the importance of understanding causal relationships in healthcare data analysis. The group was introduced to methodologies and statistical techniques for identifying causal effects, including the use of directed acyclic graphs (DAGs) and the do-calculus for controlling confounding variables. The workshop highlighted practical applications of causal inference in health research, illustrating how to apply these concepts to real-world data to inform effective and accurate decision-making.

Giovanni Angelotti facilitated the workshop on the implications of proxies and social determinants of health (SDoH) in healthcare data, with focus on disparities in treatment and outcomes. The group examined the importance of recognizing and addressing proxies of disparity in health data to ensure equitable care and research practices. They studied the critical role of data analysis and management in identifying and mitigating biases related to race, ethnicity, gender, and insurance status, aiming to improve health outcomes and care delivery.

Joe Byers facilitated the workshop that highlighted AI's potential to address healthcare disparities by improving access, diagnosis, and treatment across diverse populations. The group discussed challenges such as data bias and accessibility, and various strategies for mitigating bias in AI systems, including diverse data collection and algorithmic fairness. The presentation underscored the importance of ethical data collection and responsible AI development to ensure equitable and unbiased healthcare solutions.

Dr. Romulo de Castro co-facilitated the workshop that addressed disparities, proxies, and social determinants of health (SDoH) in healthcare. In that group, he highlighted the importance of recognizing and addressing social and environmental factors that impact health outcomes, using real-world examples like medication access issues. The session emphasized the need for healthcare systems to consider SDoH in patient care and policy making to reduce health disparities and improve overall health equity.

Competition

The "Dengue Dataset MinDSS Against Dengue" team outlined the methodology for collecting and processing dengue incidence data on a weekly basis, aggregating at regional and city/provincial levels, including cases and deaths. They demonstrated data cleaning and preprocessing techniques like outliers and null replacement with 3-day moving averages and uniform date formatting. The presentation showcased the application of LSTM (Long Short-Term Memory) networks for predicting dengue cases, demonstrating improved accuracy over traditional models and highlighting the potential of machine learning in public health decision-making and dengue prevention efforts.

The presentation titled "Scoliosis x BackBend Detectives" showcases a patient-driven registry aiming to support individuals with scoliosis in the Philippines. It highlights the development and launch of a mobile app that facilitates patient registry, community support, and access to resources, with features including QR Code Patient ID and a comprehensive guidebook. The document also discusses the challenges of data collection and proposes solutions like good data governance and AI utilization for diagnostic screening, underlining the project's role in influencing policy and healthcare practices for scoliosis patients.

Ethics of AI

Dr. Marita V. Tolentino-Reyes talked about "ETHICS IN THE USE OF AI" emphasizing the importance of ethical in AI development and use, particularly in research and teaching contexts. She listed key ethical principles such as transparency, respect for persons, beneficence, non-maleficence, and justice, highlighting the need to address biases, ensure data integrity, and promote fairness. She recommended practical strategies for educators in guiding their students in the ethical use of AI-generated content, stressing the importance of original thought, critical thinking, and academic integrity.

Dr. Charibeth Cheng addressed how AI can contribute to Universal Health Coverage (UHC) by improving diagnostic accuracy, supporting clinical decision-making, enhancing public health monitoring, advancing drug discovery, and reducing healthcare costs. She elaborated on the challenges such as bias, privacy issues, autonomy, accountability, job displacement, and the lack of regulation. She highlighted the balance between AI's potential benefits and the ethical, privacy, and regulatory challenges that must be addressed to ensure its effective and equitable use in healthcare.

Dr. Alvin Marcelo introduced the Asia eHealth Information Network (AeHIN), detailing its mission to enhance the interoperable digital health ecosystem for improved health in Asia through networking, resource sharing, and knowledge exchange. Established in 2011, AeHIN has grown to include over 1800 members across 72 countries, supporting capacity building in digital health through activities such as conferences, training, and online resources. The presentation highlights AeHIN's focus on Governance, Architecture, Program management, and Standards (GAPS) to address digital health challenges and promote effective health data management and interoperability. He then enumerated various AI initiatives in the ASEAN region.

Dr. Teehankee presented on "Ethical AI for Datathon" emphasizes the relevance of incorporating humanistic values into AI development to promote human flourishing, sustainable value creation, and productivity for the common good. He warned about the potential risks of unethical or unsafe AI, including harm to human well-being, democracy, and social values. he advocated for the use of AI in enhancing human capabilities, improving quality of life, and fostering ethical reflection and decision-making, highlighting the need for AI to support rather than undermine human needs and values.

Participation

There were130 participants in the 2023 Philippine Datathon. Not including the organizers, guests, and sponsors, there was nearly a 50% split between female and male registrants from various locations nationwide. Six of the guests were of foreign nationalities.

Participant Feedback

Name: Gillian Nicole A. Jamias Email: gillian_jamias@dlsu.edu.ph

I'm grateful for pushing myself to participate in last year's Datathon as it exposed me to a diverse crowd who are interested in drawing insights from health-related data. I felt inspired while listening to the different presentations. It made me want to be a better storyteller. Delivering the message across different perspectives and backgrounds may be daunting, but it is achievable with effort and teamwork. It was a moment to celebrate when our team placed after pitching.

Name: Amanda Glenda M. Bonife-Kiamko Email: amanda@scoliosisphilippines.org

Winning the Datathon validated my mentoring approach and boosted my confidence in my ability to lead and inspire others. It provided a sense of accomplishment and recognition that motivated me to continue advocating for the scoliosis community. Additionally, it opened new networking opportunities and professional growth, connecting me with like-minded individuals and potential collaborators in the field. Overall, the Datathon experience was both rewarding and transformative. It enhanced my skills, expanded our network, and reaffirmed my commitment to advocacy by following best practices and data-driven sources in shaping Universal Health Care (UHC).

Name: Robbie Mondia Email: pr.robbie.mondia@gmail.com

Joining and unexpectedly winning in the Philippine Datathon 2023 was a game-changer for me, especially in terms of developing potential tools for addressing a less commonly discussed issue: scoliosis. This experience significantly broadened my perspective on the importance of creating accessible technology, particularly for untapped datasets. In the Philippines, where healthcare can be prohibitively expensive for many, the need for affordable and innovative solutions is critical. Winning the event highlighted the possibilities and potential impact of our work, inspiring us to focus on building tools that can make a real difference in people's lives. By developing technology tailored to the specific needs and constraints of underserved communities, we can contribute to a more inclusive healthcare system where treatment and support for conditions like scoliosis are within reach for everyone.

Name: Gabriel M. Galang Email: gabriel.galang@bulsu.edu.ph

Firstly, I thoroughly enjoyed the event. It was an incredible experience that opened a door for me into the world of data analytics and machine learning. The opportunity to learn and engage with these fields was invaluable. Winning was just a bonus; the real prize was the knowledge and experience I gained. I'm looking forward to participating in more events like this in the future.

Name: Carlos Angelo Rayos Email: rayos.carlosangelo@gmail.com

I became more aware of the larger community working in data, not just in machine learning but even in data engineering and other fields. Meeting with different people from different fields who see the potential from data, their experiences, goals, and projects were very educational. I also got to talk with some people whose masters / degrees I was interested in pursuing, and they gave very inspiring insights.

Name: Justine William T. Duran Email: jusduranmd@gmail.com

As a physician who is deeply interested in the application of health technology specifically artificial intelligence to real world problems, this was a never-before-seen opportunity to practice working with talented people from different backgrounds and actual data scientists, computer scientists, and artificial intelligence experts which was profoundly enriching. The problem faced by our partners who gave us access to their data, scoliosis Philippines, was one that was deeply fulfilling to work towards as this event gave them insights to their data that left them with actionable ideas that profoundly changed their view on the value of their data and how it can forward their cause of solving the financing problem of people with scoliosis. On a personal level, this gave me the confidence to work on similar projects and is a vital steppingstone into the world of health informatics as I move forward with my career as a physician researcher by building relationships

with vital collaborators through a common goal of leveraging health data for improving the healthcare outcomes of society.

Name: Rizzi Meia Palma Email: rizzi1108@gmail.com

Joining last year's Datathon was a transformative experience for me, both professionally and personally. More than just learning about how AI can revolutionize healthcare, one of the most impactful aspects was the opportunity to meet new people who are deeply passionate about what they do. The event brought together a diverse group of individuals from various backgrounds, each with unique perspectives and expertise. This diversity was a catalyst for creativity and innovation, allowing us to approach problems from multiple angles and find more comprehensive solutions.

Being part of the winning group was not just a professional achievement but also a powerful validation of the importance of diversity in teamwork. It reinforced the idea that when people with different skills, experiences, and viewpoints come together, the potential for breakthrough ideas and effective problem-solving increases exponentially. I especially commend the organizers for including patients in last year's Datathon.

On a personal level, the Datathon was a confidence booster. It was a reminder that stepping out of my comfort zone and engaging with new challenges can lead to significant growth and unexpected rewards.

Overall, the Datathon was more than just a competition; it was a journey of learning, connection, and validation. It has had a lasting impact on how I approach my work in healthcare and AI, emphasizing the power of diversity and collaboration in driving progress and achieving excellence.

5. Discussion

There was consensus among participants that emerging technologies like artificial intelligence bring benefits and risks. The audience was particularly interested in how to address the problems with AI such as bias, forgetfulness, and hallucinations. A rigorous exchange occurred at the last session on Ethics of AI with panelists and experts in the audience challenging that ethics boards may have fallen short in protecting the vulnerable when it comes to AI research and implementation.

6. Conclusion and Future Directions

The datathon was able to bring local and international faculty and students to discuss state-of-the-art in data governance and management in the Philippines. While there was interest from all participants on a data-driven future, they also expressed apprehensions on the security, privacy, and ethical use of data. There was consensus that more capacity-building opportunities should be made available to as many stakeholders as possible. More discourse on the aforementioned topics is recommended with particular emphasis on ethics and its positive and negative impact on the field of data analytics.

7. Acknowledgements

CARE PH for events management
De La Salle University for the venue
MIT Critical Data Team as mentors
UP Manila National Telehealth Center for coordination

APPENDIX C

MEMORANDUM OF UNDERSTANDING
CANCER RESEARCH STUDIES

This Memorandum of Understanding (MOU) was made and executed this ____ day of _________ 202_, in Pasig City, Philippines between:

The **CANCER CARE REGISTRY PHILIPPINES FOUNDATION, INC**, with its principal office at Rm 406 Medical Arts Tower Building, The Medical City, Ortigas Avenue, Pasig, Metro Manila, represented herein by its President and Chief Executive Officer, **BEATRICE J. TIANGCO, M.D., MSCE,** hereinafter referred to as **"CARE PH"**;

-and-

The **UNIVERSITY OF THE PHILIPPINES**, the national university, created under Act No. 1870, as amended by Republic Act No. 9500, otherwise known as *The University of the Philippines Charter of 2008*, with official address at the 2nd Floor North Wing, Quezon Hall, U. P. Campus, Diliman, Quezon City, represented herein by its President, **ATTY. ANGELO A. JIMENEZ**, hereinafter referred to as **"UP"**;

CARE PH and **UP** are collectively referred to as the **"Parties"**

This MOU is intended to reflect the mutual understanding of the institutions. The Parties agree that nothing in this MOU is legally binding or capable of generating any contractual obligations.

WITNESSETH: that

WHEREAS, the CARE PH envisions "Better healthcare for the Filipino cancer patient" and has as its Mission "every preventable cancer averted, every screenable cancer detected, every cancer patient counted";

WHEREAS, the CARE PH aims to reach its mission and vision through the building of hospital-based cancer registries (HBCR) throughout public and private hospitals in Luzon, Visayas, and Mindanao, including the National Capital Region, Iloilo and Davao, which share their de-identified data with the CARE PH central database

WHEREAS, the CARE PH also aims to support specialty oncology societies in building their own specialty or site-specific cancer registries which can easily integrate their de-identified data with the CARE PH HBCR Central database, and use these registries to gather robust big data to facilitate cancer research and the building of a Philippine Cancer Precision Medicine Platform (PCPMP),

WHEREAS, the CARE PH-PCPMP requires not just cancer registry data, but also data from electronic medical records and health information records of cancer patients, and has therefore built its own electronic medical record (EMR) embedded in its CARE PH HBCR application,

WHEREAS, the UP, through its Philippine Genome Center (PGC), is offering a full range of whole genome sequencing, biobanking, and Bio-information services and other services such as liquid chromatography and mass spectrometry, genetic and genomic profiling that are requested by oncology practitioners and clinical researchers, the results of which are kept in their hospital EMR, that will efficiently meet clinical practice and research goals,

V. G. Bulatao
VICTOR GERARDO BULATAO, MPA
Treasurer, CARE PH

BEATRICE J. TIANGCO, M.D., MSCE
President and CEO, CARE PH

MICHAEL C. VELARDE, Ph.D.
FELICITAS L. LACBAWAN, M.D.
Executive Director, UP PGC

ATTY. ANGELO A. JIMENEZ
President, UP System

VLA

WHEREAS, the PGC has satellite facilities in Iloilo and in Davao, that can cater to the genetic, genomic, biomolecular and biobanking service needs of cancer patients and cancer researchers,

WHEREAS, the Parties have mutual interests in building a Philippine Cancer Precision Medicine Platform (PCPMP) to be used to further cancer research in the country,

NOW, THEREFORE, for and in consideration of the above premises, and of the mutual covenants hereunder set forth, the two parties hereto have agreed as follows:

JOINT ACTIONS

1. The Parties may undertake joint consultations, hospital expeditions, seminars and conferences and carry out such programs as are directly responsive to the cancer research and biobanking needs across the country;
2. The Parties may undertake joint research in such other biological fields as are relevant to the enhancement of its mutual purposes;
3. The development and implementation of specific activities to implement the MOU will be separately negotiated and agreed upon by the Parties and will be the subject of separate definitive written agreements. The Parties agree to carry out these activities following their respective policies. It is understood that the implementation of any of the joint activities may be restricted depending upon the availability of resources and funds of the respective Parties; and
4. In the event of research collaboration leading to publications, patents, copyrights, or other intellectual property rights, a further agreement shall be negotiated in each case following the policies of the Parties on intellectual property. The Parties shall seek an equitable and fair understanding as to the ownership and other property interests that may arise in the course of a research collaboration, the terms of which shall then be contained in a separate definitive agreement that shall be based on the laws, rules, and guidelines then implemented in each institution.

INFORMATION SHARING

1. The Parties agree to collaborate and coordinate with each other on data sharing and application of science to advance precision medicine in cancer work across the country.
2. The Parties mutually agree that they will process personal information and sensitive personal information in conformity with the provisions of Republic Act No. 10173 (Data Privacy Act of 2012), and all other applicable laws and regulations.
3. The Parties shall ensure that appropriate organizational, physical, and technical measures are in place to maintain the confidentiality, integrity and security of personal information and sensitive personal information that may come to its knowledge or possession by reason of any provision of this MOU and that its employees, agents, representatives, or any person acting under its authority shall hold said information under strict confidentiality at all times.
4. Both Parties undertake to observe the confidentiality and secrecy of documents, information, and other data received from or supplied to the other party during the period of the implementation of this agreement or any other agreements made pursuant to this agreement. The Parties agree that the provisions of this article shall continue to be binding between both Parties notwithstanding the expiration or termination of this Agreement.

MUTUAL SUPPORT

1. The Parties may provide mutual and available support including but not limited to administrative and financial as well as other resources to ensure the success and accomplishment of the above undertaking.

ATTY. ANGELO A. JIMENEZ
President, UP System

MICHAEL C. VELARDE, Ph.D.
~~FELICITAS L. LACBAWAN, M.D.~~
Executive Director, UP PGC

BEATRICE J. TIONGCO, M.D., MSCE
President and CEO, CARE PH

V.G. Bulatao
VICTOR GERARDO BULATAO, MPA
Treasurer, CARE PH

VLA

2. The Parties commit to abide by all Philippine laws and regulations in its pursuit of programs and projects on biodiversity conservation relative to the above undertaking.

ACKNOWLEDGMENT OF DATA

1. Any publication arising through any collaborative project shall clearly establish and identify the Parties as the sources of the output.
2. The names of the principal investigators, researchers and/or project leaders of the Parties shall be identified, recognized and included in all pertinent reports about collaborative studies under any collaborative project.

EFFECTIVITY AND TERM

This MOU shall take effect on the date first written above.

This MOU is effective for two (2) years, beginning on October 14, 2024, and ending on October 13, 2026. The MOU can be modified during this 2-year period with the written consent of both parties.

After two years, this partnership may be extended either by an amendment signed by the parties or by the parties signing a new MOU. At such time, the terms of this MOU may be changed.

A party may withdraw at any time upon thirty (30) days advanced written notice to the other party. Any termination should be without prejudice to the completion of any ongoing activity between the Parties.

DISPUTE RESOLUTION

In the event there is a dispute between the Parties regarding this MOU, both Parties agree to freely and voluntarily submit themselves to necessary consultation and negotiation for purposes of amicable settlement and to find a mutually acceptable solution to their dispute. Should the Parties fail to reach an amicable settlement of the dispute, the same shall be submitted to arbitration following Republic Act No. 9285, otherwise known as the "Alternative Dispute Resolution Act of 2004". However, should the dispute between the Parties reach the courts of law, the Parties agree that the competent courts of Quezon City shall be the exclusive venue, to the exclusion of all other courts or tribunals.

OTHERS

The Parties agree that this MOU is not intended to create a legal partnership, joint venture or other such business arrangement, nor is the purpose of the Parties to enter into a commercial undertaking for monetary gain. No party will refer to or treat the arrangements under this MOU as a legal collaboration or take any action inconsistent with such intention.

Nothing in this MOU will constitute or be deemed to constitute any party as the legal representative or agent of the other, nor will any party have the right or authority to assume, create, or incur any liability or obligation of any kind, expressed or implied, in the name or on behalf of any of the other.

ATTY. ANGELO A. JIMENEZ
President, UP System

MICHAEL C. VELARDE Ph.D.
FELICITAS L. LACBAWAN, M.D.
Executive Director, UP PGC

BEATRICE J. TIANGCO, M.D., MSCE
President and CEO, CARE PH

VICTOR GERARDO BULATAO, MPA
Treasurer, CARE PH

IN WITNESS WHEREOF, the parties hereto have acknowledged and agreed to execute this Memorandum of Understanding this ____ day of _________ 202_.

CANCER CARE REGISTRY PHILIPPINES FOUNDATION, INC	UNIVERSITY OF THE PHILIPPINES
By:	By:
BEATRICE J. TIANGCO, M.D., MSCE President and Chief Executive Officer	**ATTY. ANGELO A. JIMENEZ** President

VLA

SIGNED IN THE PRESENCE OF:

V. G. Bulatao	MICHAEL C. VELARDE, Ph.D.
VICTOR GERARDO BULATAO, MPA Treasurer Cancer Care Registry Philippines Foundation, Inc.	**FELICITAS L. LACBAWAN, M.D.** Executive Director UP Philippine Genome Center

ACKNOWLEDGMENT

REPUBLIC OF THE PHILIPPINES)
CITY/MUNICIPALITY OF QUEZON CITY)

14 OCT 2024

BEFORE ME, this ____day of __________ 20__, personally appeared:

NAME	PROOF OF IDENTIFICATION	DATE AND PLACE OF ISSUE
BEATRICE J. TIANGCO, M.D., MSCE *President and CEO, CARE PH*	Phil Passport NO. P933 2331A	25 MAY 2018 DFA MANILA
ATTY. ANGELO A. JIMENEZ *President, UP System*	P3343531B	25 Sept. 2019 DFA MANILA

both known to me to be the same persons who executed the foregoing instrument, and who acknowledged to me that the same is their free act and deed, as well as the juridical entities they represent herein.

This instrument refers to a "Memorandum of Understanding" consisting of five (5) pages including the page whereon this acknowledgement is written, and which is signed by the Parties and their instrumental witnesses on each and every page thereof and sealed with my notarial seal.

IN WITNESS WHEREOF, I have hereunto set my hand on the date and at the place first written above.

ATTY. EUGENIA A. BORLAS
Notary Public for Quezon City; Com. Expires on 12/31/2024
A.M. No. NP 154, 2/14/2023, Quezon City
No. 3 Mahinhin St., U.P. Village, Diliman, Quezon City
Roll No. 3758[illegible]; MCLE No. VIII-0004505, 10/25/2023
IBP No. 387951, 1/2/2024, QC; PTR No. 5555090, 1/2/24, QC
eaborlaslaw@yahoo.com; 09176257044, (02) 8-925-7471

Notary Public

Doc. No. 127;
Page No. 35;
Book No. II;
Series of 2024

ATTY. ANGELO A. JIMENEZ
President, UP System

MICHAEL C. VELARDE Ph.D.
FELICITAS L. LACBAWAN, M.D.
Executive Director, UP PGC

BEATRICE J. TIANGCO, M.D., MSCE
President and CEO, CARE PH

V.G. Bulatao
VICTOR GERARDO BULATAO, MPA
Treasurer, CARE PH

UNIVERSITY OF THE PHILIPPINES
Diliman Los Baños Manila Visayas Open University Mindanao Baguio Cebu Tacloban

Philippine Genome Center
OFFICE OF THE VICE PRESIDENT FOR ACADEMIC AFFAIRS

06 SEPTEMBER 2024

MEMORANDUM NO. FLL 24-026

FOR	:	**MICHAEL C. VELARDE, PHD** Program Director, Biobank Core Facility *(Conforme)*
FROM	:	**FELICITAS L. LACBAWAN, MD** Executive Director
RE	:	**DESIGNATION AS OFFICER-IN-CHARGE ON SEP 07 - 20, 2024**

You are hereby appointed as Officer-in-Charge of the Philippine Genome Center while I am in the U.S.A. As Officer-in-Charge, you are authorized to sign transactions including but are not limited to the following day-to-day transactions:

- Personnel related documents e.g., hiring files, DTRs, certifications etc.
- RA 9184 related documents e.g., PPMP, PRs, Purchase Orders etc.
- Payable related documents e.g., billing, disbursement vouchers etc.
- Official reports or communications relevant to the Center's operations.

I will continuously monitor important PGC matters, and can be reached via email or Viber for critical matters. Thank you!

Cc: OVPAA
R&D Programs

Philippine Genome Center
Ma. Regidor Street, PGC Building, UP Diliman Campus,
Quezon City 1101, Philippines
Website: https://pgc.up.edu.ph
Email: pgc@up.edu.ph
Phone: (02) 8981-8500 loc. 4703/4704

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Diliman, Quezon City
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Phone: (02) 8981-8722; 8981-8500 loc. 2528

APPENDIX D CAPSULE PROPOSAL

A HOUSE-TO-HOUSE SURVEY ON THE HEALTH-RELATED SYMPTOMS, NEEDS, AND WANTS OF THE FILIPINO PUBLIC IN TWO BARANGAYS IN LANAO DEL NORTE AND ZAMBOANGA DEL SUR

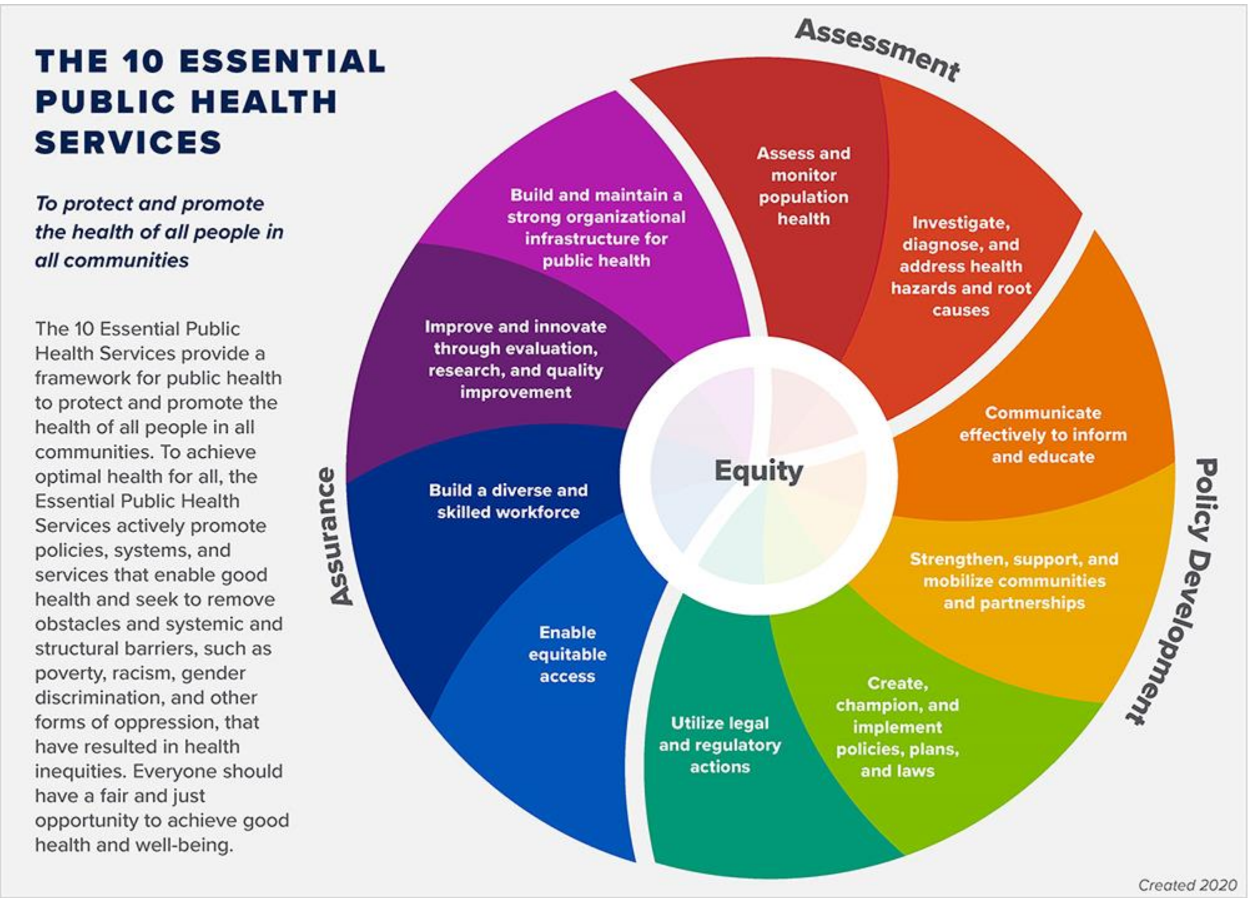
BACKGROUND

In response to international requests to prevent future pandemics and to promote health sustainably, the Quadripartite Organizations – the Food and Agriculture Organization of the United Nations (FAO), the United Nations Environment Programme (UNEP), the World Organization for Animal Health (WOAH) and the World Health Organization (WHO)-- developed the One Health Joint Plan of Action (2022-2026) [1].

The World Health Organization’s publication “Monitoring the Building Blocks of Health Systems” emphasizes the six system building blocks or core components of a health system [2]. These are service delivery, health workforce, health information systems, access to essential medicines, financing, and leadership/governance. This building block approach to human health systems is the foundation upon which One Health Systems [3] can be built.

The Declaration of Principles and Policies contained within the Implementing Rules and Regulations (IRR) of RA11223 establishing the Universal Healthcare Act of the Philippines states that “a people-oriented approach for the delivery of health services that is centered on people's needs and well-being, and cognizant of the differences in culture, values, and beliefs” shall be embodied by the UHC Act. [4]

This study carries out the UHC mandate by first determining what are the people’s health needs and wants that affect their sense of well-being. This will be carried out in three phases as seen in Fig 1 [5] where phase 1 is the Assessment Phase, Phase 2 will be the Assurance Phase, and Phase 3 will be the Policy Development Phase.



The 10 Essential Public Health Services provide a framework for public health to protect and promote the health of all people in all communities. To achieve optimal health for all, the Essential Public Health Services actively promote policies, systems, and services that enable good health and seek to remove obstacles and systemic and structural barriers, such as poverty, racism, gender discrimination, and other forms of oppression, that have resulted in health inequities. Everyone should have a fair and just opportunity to achieve good health and well-being.

Figure 1. Ten essential public health services 2020

OBJECTIVES

General objective: To develop a primary healthcare service delivery manual that will address the healthcare needs and wants of a pilot community while working within the LGU's health budget, without increasing the need for funding from outside sources

Specific objectives:

- To assess the healthcare needs and wants of one or two pilot communities
- To identify the gaps in the current primary healthcare delivery system that, once filled, will assure better healthcare service delivery to the community
- To create new policies or update existing policies of the community that address the health and wellbeing of its citizens

- To maintain and continuously improve the primary healthcare delivery system by creating a dashboard of the community's health needs and wants and keep track of community health status, healthcare service delivery gaps, leading to revision of health policy, when needed

METHODOLOGY

PHASE 1 Survey Assessment

The ecology of medical care, visually represented in a landmark paper by White, et al [5] in 1961, shows the spectrum of healthcare behavior “from the ground up”.

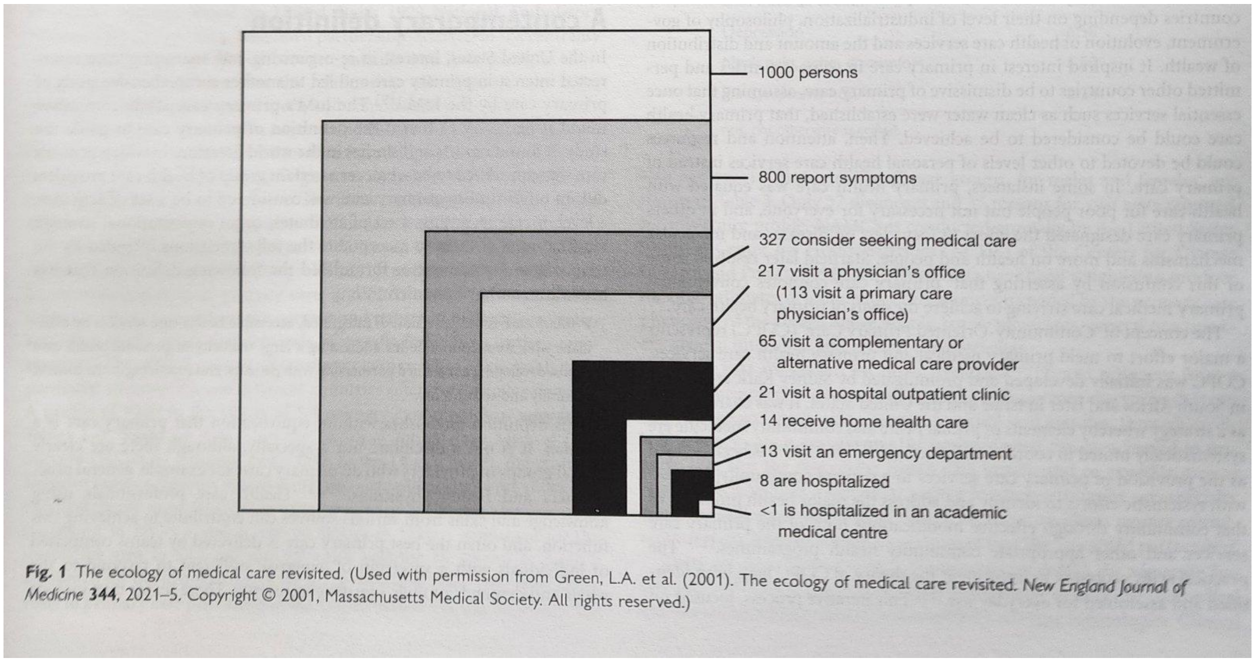


Fig. 1 The ecology of medical care revisited. (Used with permission from Green, L.A. et al. (2001). The ecology of medical care revisited. *New England Journal of Medicine* **344**, 2021–5. Copyright © 2001, Massachusetts Medical Society. All rights reserved.)

Figure 2. Sample ecology of medical care

While current approaches to primary health first survey health symptoms of the 217 adult patients in Fig 1 who are seen by general practitioners or internists in health care centers, this study goes deeper into the 1000 adults in a pilot community who may or may not experience any mental or physical symptoms of ill-health and will analyze the results in order to come up with the community’s health symptoms, needs and wants, including the prevalence of any of the 10 early warning signs of cancer.

PHASE 2 Assurance

PHASE 3 Policy Development

PROJECT TEAM Phase 1

- Project Lead
- Project Co-Lead and Patient Advocate from Barangay 1
- Project Co-Lead and Patient Advocate from Barangay 2
- Project Manager
- Social Scientist/Statistician

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