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Perspective

Taiwan's Nationwide Cancer Registry System of 40 years: Past, present, and future



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The Taiwan Cancer Registry (TCR) is a nationwide population-based cancer registry system that was established by the Ministry of Health and Welfare in 1979. The data of patients with newly diagnosed malignant cancer in hospitals with 50 or more beds in Taiwan are collected and reported to the TCR. To evaluate cancer care patterns and treatment outcomes in Taiwan, the TCR established a long-form database in which cancer staging and detailed treatment and recurrence information has been recorded since 2002. Furthermore, in 2011, the long-form database began to include detailed information regarding cancer site-specific factors, such as laboratory values, tumor markers, and other clinical data related to patient care. Additional details about the history and activities of the TCR have been well-documented.^{1,2} Following the enactment of the Cancer Control Act in 2003, the data quality and completeness of the TCR database were improved and standards of excellence have been continuously maintained. Specifically, the completeness of the TCR is 98.4%; the percentage of cases with death certificate only is 0.9%; the mortality versus incidence ratio is 45.1%; the percentage of morphological verification is 93.0% for all sites combined and 97.6% for all sites excluding the liver; and the data timeliness is 14 months (Table 1). These data

demonstrate that the TCR is one of the highest-quality cancer registries in the world.³

The TCR publishes annual cancer statistics for all cancer sites, and the TCR's accurate data is used for policy making and academic research. For example, the Health Promotion Administration (HPA) in Taiwan has implemented national screening programs for cancers of the cervix uteri, oral cavity, colon, rectum, and female breast,⁴ and the TCR database has been employed to verify the effectiveness of these nationwide cancer screening programs for reducing cancer burdens in Taiwan.^{5,6} Additionally, liver cancer was once a major health problem in Taiwan; however, since the implementation of the National Immunization Program and the National Viral Hepatitis Treatment Program, the incidence and mortality of liver cancer in Taiwan has significantly decreased.⁷ A recent TCR database study projected that the secular trend of liver cancer incidence for both sexes will continue to decrease by 27%–37% from 2015 to 2035.⁸

The TCR and the Taiwan Society of Cancer Registry (TSCR) have been working closely to develop and promote uniform data standards for cancer registration. Additionally, these databases periodically undergo field data audits based on medical chart reviews to ensure data accuracy.² The TSCR is a professional organization that collaborates with reporting hospitals, clinical professionals, and governmental agencies. The TSCR provides education and counseling services to registrars to help them enhance their professional skills. The TSCR also offers certification for basic and advanced cancer registrars.

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Table 1 Data quality indicators of the Taiwan Cancer Registry after enactment of the Cancer Control Act in 2003.

Indicator	Year of diagnosis													
	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Completeness ^a	95.5	94.3	96.7	97.6	97.8	97.6	97.6	97.0	97.7	98.4	98.4	98.2	98.2	98.4
Percentage of death certificate only ^b	2.6	2.3	1.7	1.4	1.3	1.2	1.1	0.8	0.8	0.7	0.8	0.9	0.8	0.9
Mortality verse incidence ratio ^c	55.5	51.2	51.8	50.0	50.5	47.1	44.4	44.0	44.9	44.3	44.1	44.0	43.8	45.1
Percentage of morphological verification ^d	87.1	88.5	88.1	88.8	89.5	90.1	90.5	90.9	91.2	91.4	91.8	92.4	92.6	93.0
Percentage of morphological verification ^d (excluding liver cancer)	94.4	95.2	95.1	95.3	96.0	96.3	96.3	96.4	96.7	96.8	97.1	97.2	97.4	97.6
Timeliness ^e	24	23	17	17	17	17	17	17	17	17	17	16	16	14

^a Completeness (%): all registered cancer cases divided by all potential cancer cases from profiles of death certificate, NHI catastrophic illnesses, and four major cancer screening programs.

^b Percentage of death certificate only (DCO): proportion of incident cases with information based on DCO.

^c Mortality verse incidence ratio (%): crude mortality rate divided by crude incidence rate (measured during the same period) of an invasive cancer.

^d Percentage of morphological verification (MV): proportion of incident cases with histological or cytological verification of cancer diagnosis.

^e Timeliness (months): interval between the date of diagnosis and the date at which the case was reported to the central cancer registry system.

Healthcare quality for patients with cancer directly influences the survival rate of this population. In 2004, the HPA developed core measurement indicators to assess the care quality associated with major cancers in Taiwan, and the National Health Research Institutes (NHRI) in Taiwan established the "Cancer Treatment Quality Certification" system and related operational standards in 2008.^{1,4} The goal of the certification standard is to help hospitals establish cancer health care structures and cancer treatment schemes. Evaluated hospitals are required to create holistic cancer committees to plan and supervise their cancer operations, implement plans for cancer registration information and product management, form professional cancer healthcare teams, devise clinical treatment indices, and formulate standard operating procedures for administering health care. Since 2010, the TCR has regularly provided feedback based on cancer survival data to reporting hospitals to help these institutions improve patient care. In addition, the TCR provides requisite data to the HPA and NHRI to enable monitoring of core cancer measurement indicators in individual hospitals. At the end of 2017, a total of 58 hospitals had passed the certifications.⁴ These hospitals accounted for treatment of nearly 90% of incident cancer cases in Taiwan.

The national cancer registry of Taiwan has been operated smoothly for 40 years. In addition to cancer registration data, numerous other health information profiles are recorded in Taiwan, such as death certificate data, national health insurance claim data, cancer screening data, national biobank data, and health survey data. In 2011, the Health and Welfare Data Science Center (HWDC) began operations to enhance the quality of public health decision-making and promote related academic research. The HWDC integrates all of Taiwan's health information databases to provide a foundation for personalized medicine and thereby enable health care

professionals to develop predictive, preventive, personalized, and participatory (P4) medical visions. Artificial intelligence (AI)-based distributed machine learning techniques and cutting-edge statistical methods are playing increasingly critical roles in health data sciences.⁹ AI-based auto-abstracting may help registrars enhance the quality and timeliness of routine cancer reporting. The application of big data with AI to the development of new tools and systems will usher in a new era of quality in clinical cancer treatment and introduce exciting breakthroughs in patient care. The success of these efforts requires collaboration among government agencies, health facilities, academic institutes, and the technology industry.

Conflicts of interest

None of the authors have conflicts of interest to disclose.

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Appendix A. Supplementary data

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