**SDC 6: Estimating direct medical costs**

The economic burden of RVGE in Malaysia is dependent on unit cost estimates for inpatient and outpatient care at both public and private health facilities in Malaysia. Direct medical costs were calculated based on per bed-day inpatient costs multiplied with the duration of admission for hospitalizations and costs per-visit for outpatient visits.

Since unit costs are not readily available in Malaysia, we utilize methods previously used in the estimation of the economic burden of dengue in Malaysia [12, 13]. Multiple data sources were combined for this estimation, including hospital annual reports from five tertiary-level hospitals, local costing studies at six primary-level hospitals and eleven health clinics around the country and World Health Organization-CHOosing Interventions which are Cost-Effective (WHO-CHOICE).

**WHO-CHOICE project**

The WHO-CHOICE (World Health Organisation – CHOosing Interventions which are Cost-Effective) project was initiated in 1998 to assist countries in making rational choices based on evidence generated by cost-effectiveness analyses [14].

The WHO-CHOICE project allows for estimation of unit cost of inpatient and outpatient care by 191 member states, through data collected from 49 countries [15, 16]. Presumably because of the lack of suitable data, Malaysia had not been included in this list of countries contributing data. Using econometric modeling, the WHO-CHOICE project predicts unit costs for countries in which data were not available. In the case of Malaysia, especially since Malaysian data was not obtained for the WHO-CHOICE project, it is preferable to use local data for costing.
The facility-types used in the WHO-CHOICE project refers to differences in service characteristics, including difference in case-mix, technical capacity and skills available in facilities [15].

In our study, costs for facility levels from WHO-CHOICE project (primary-level, secondary-level and teaching hospitals) were used for estimation of unit-costs for inpatient bed-days at public hospitals. For the estimation of unit-costs for outpatient visits (public hospital and clinics), facility levels used were health facilities with no beds, primary and secondary-level hospitals [15, 17].

**Unit costs at public clinics**

A 1995 costing study on the provision of outpatient services in 11 MOH public clinics in Kedah was conducted by Lim KJ provided costs per-visit of US$ 3.75 in 2013 US$ [12, 18]. Information on costs was collected for personnel, supplies, utilities, maintenance and training, and was derived mainly from the operating budget of the clinics involved. We deemed this unit cost of US$ 3.75 for public clinics in Malaysia or similar to ‘health facilities with no beds’ from WHO-CHOICE [14, 17].

**Unit costs at primary-level hospitals**

A study by Sabrina AR in 2001 estimated unit costs at six primary-level or district hospitals around Malaysia for the year 2001. This study provided us with average costs for primary-level hospitals of US$ 43 per-visit (range: US$ 10 to US$ 78 per-visit) in 2013 US$.

All the selected hospitals in this study were 93 bedded facilities with basic medical and surgical services provided by doctors without specialist qualifications, hospitals which were considered by the MOH as belonging to the category of “district hospitals without specialists” [19].
Unit costs at tertiary-level hospitals

We conducted top-down costing of five urban, tertiary-level public hospitals in Malaysia. The hospitals selected were University of Malaya Medical Center (UMMC), Hospital Sungai Buloh (HSB), Hospital Sultanah Bahiyah, Alor Setar (HAS), Hospital Melaka (HM) and Hospital Sultan Haji Ahmad Shah, Temerloh (HT).

The UMMC is a tertiary-level, teaching hospital administered by the Ministry of Education. The operating expenditure and workload of UMMC was obtained from the 2012 hospital annual report and updated to include salaries of academic clinicians. Academic clinicians are employed by the university, and as such their salaries are not included in the hospital’s operating expenditure. We made the assumption that the academic clinicians spent 60% of their time on clinical service, while the remaining time was spent on academic and research duties. [12] The cost of an outpatient visit was assumed at a fifth the cost of an inpatient day at tertiary-level hospitals.

We searched hospital websites individually for annual reports of tertiary-level Ministry of Health (MOH) hospitals. We also hand-searched for annual reports at the MOH library at Putrajaya. The lack of standardized formats and availability of information on admission rates, clinic attendances, bed occupancy rate, hospital expenditure and others limited our selection to 4 tertiary-level MOH hospitals.

We estimated of unit-costs at tertiary-level hospitals based on the average costs obtained from UMMC and these 4 hospitals (SDC 7). Average costs at tertiary-level hospital was estimated at US$ 341 per-bed day and US$ 68 per-visit.

Description of tertiary-level hospitals

University of Malaya Medical Center (UMMC)
UMMC is a 979 bedded, tertiary-level, teaching hospital administered by the Ministry of Education. UMMC is located in Kuala Lumpur, and is the only public hospital serving the bordering the city of Petaling Jaya, with a population of approximately two million people.

Hospital Sungai Buloh (HSB)
Hospital Sungai Buloh is a 620 bedded, tertiary-level hospital located about 25 km from the capital city of Kuala Lumpur, in the state of Selangor. This hospital serves about approximately 2.18 million people or 40% of the population of Selangor. It is known as a center of excellence for the management of infectious diseases, emergency medicine and traumatology, neurosurgery, maxillo-facial surgery, plastic and reconstructive surgery and spinal surgery.

Hospital Sultanah Bahiyah, Alor Setar (HAS)
Hospital Sultanah Bahiyah, Alor Setar is an 870 bedded tertiary-level hospital located in Alor Setar in the northern state of Perlis. Hospital Sultanah Bahiyah, Alor Setar serves as a regional referral center for 12 clinics in Perlis and 8 state hospitals in the northern region of Malaysia. This hospital provides tertiary-level clinical services in 12 specialties, with 28 clinical consultants providing sub-specialty services including cardiology, nephrology, plastic and reconstructive surgery and maxillofacial surgery.

Hospital Sultan Haji Ahmad Shah, Temerloh (HT)
Hospital Sultan Haji Ahmad Shah, Temerloh is a 500 bedded, tertiary-level hospital serving approximately 900 thousand people in 6 districts in the state of Pahang. In 2012, Hospital Sultan Haji Ahmad Shah, Temerloh employed 2,042 staff, including 31 Clinical Specialists. This hospital provides tertiary-level services in 12 specialties and sub-specialty services including oral-maxillary-facial surgery, pediatric dentistry, and oral surgery.

Hospital Melaka (HM)
Hospital Melaka is a 1,091 bedded, tertiary-level hospital serving approximately 800 thousand people in Melaka and 4 neighboring districts in Johor. Hospital Melaka is second only to Hospital Kuala Lumpur, in number of operational beds among MOH hospitals in Malaysia. It provides services in 17 clinical specialties and sub-specialty services including plastics and reconstructive surgery, oral surgery, dermatology, pediatric dentistry.

**Costing of hospital bed-days**

In this current study, we use methods previously utilized in the estimation of dengue burden in Malaysia [12]. In 2010, a two-stage expert workshop, gathered experts from the public and private health sectors and academia to discuss issues arising in the estimation of dengue disease burden and costing, due to insufficient data [20].

Two main conclusions from this expert workshop are used in our present study.

Firstly, the workshop participants had agreed that the description of tertiary-level or teaching hospitals, as provided by WHO-CHOICE, could refer to the state-level, national referral centers or teaching hospitals in the public sector in Malaysia, including UMMC. The Malaysian district hospitals could be categorized as either primary-level or secondary-level hospitals depending on the services provided. In the case of smaller district hospitals without specialists or with few basic specialties, the participants agreed that they should be categorized as primary-level hospitals. These would include the six district hospitals in the 2001 costing study [21]. The remaining district hospitals could be considered as secondary-level hospitals.

Secondly, inpatient care at each hospital-type was assumed to be proportional to the number of beds in these facilities. The expert panel in the dengue study, agreed that the number of tertiary-level beds made up 50% of all hospital beds in the country. The corresponding figures for secondary and primary level hospital beds were 30% and 20% respectively. [12].
We assumed that inpatient care for diarrhea at each hospital-type was proportional to the number of beds in these facilities. Distribution of hospitals by number of beds was derived from the expert workshop in the dengue study [12].

Cost estimates by facility-type from WHO-CHOICE was used to derive cost-ratios, or the ratio of unit costs for primary and secondary facilities compared to costs at tertiary-level facilities. Unit costs per bed-day for primary-level hospitals are 74% of costs at tertiary-level hospitals (average costs from UMMC and the 4 tertiary-level hospitals). These cost-ratios were applied to unit cost estimates for tertiary-level hospitals and the distribution of healthcare facility by type, to derive average costs per bed-day at public hospitals of US$ 300.

The unit cost estimates for tertiary-level hospitals of US$ 341 per bed-day and US$ 68 per-visit (average costs from UMMC and the 4 tertiary-level hospitals), were assumed to be equivalent to costs of private facilities.

Duration of admission for an episode of RVGE (3.3 days) was obtained from a 2010 prospective study conducted in two hospitals in Malaysia [11, 22]. (SDC 8)

**Costing of outpatient visits**

Distribution of care to outpatient facilities was based on unpublished data from MOH, Malaysia. Clinic attendances to MOH facilities for childhood diarrhoea in 2012, showed that 56% of outpatient visits were to health facilities with no beds and the remaining were to hospitals [23]. We apportioned outpatient care at each hospital type as proportional to the number of beds in these facilities (conclusion of expert panel discussion in Dengue study). As such we distributed the remaining 44% of outpatient visits to tertiary-level (50%), secondary-level (30%) and primary-level (20%) hospitals.
Cost estimates by facility-type from WHO-CHOICE was used to derive the ratio of unit costs for secondary-level hospitals compared to costs at primary-level hospitals. Unit costs per outpatient visit for secondary-level hospitals are 141% of the costs at primary-level hospitals (from the Sabrina AR study).

Costs per-visit to public health clinics (health clinics with no beds) was derived from the 1995 costing study by Lim KJ of US$ 4. Average costs per-visit from UMMC and 4 MOH hospitals of US$ 68 was applied to tertiary-level hospitals.

Our estimate for the average cost per-visit for outpatient care is US$ 29 (US$ 4 for public clinic visits, US$ 61 for public hospital outpatient visits and US$ 68 for private clinic visits).

See SDC 8 for estimation of unit costs at healthcare facilities in Malaysia.
References


