

# Assessment of Data Quality in Hospital Reporting on Sumatra Island in 2023 through the RS Online Application

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**Abstract.** One of the uses of technology in the healthcare sector is the implementation of health information systems (HIS). An example of HIS implementation in Indonesia is RS Online. RS Online is part of the hospital information system used for routine hospital reporting by adjusting data and information needs at the Ministry of Health. Data from health facilities, such as hospital data in RS Online, are the main data source for evaluating the performance of the health sector. Data urgency arises due to the importance of data quality and its resulting impacts. The aim of this research is to determine the level of hospital reporting data quality on Sumatra Island in 2023 on the RS Online application. This research was quantitative with a cross-sectional design. The sample consisted of 753 hospitals on Sumatra Island, which was determined by total sampling. The results of routine data quality assessment reached 100% in the uniqueness dimension, 94.59% in the completeness dimension, 98.71% in the accuracy dimension, and 99.52% in the validity dimension. The results show that the routine hospital reporting data quality on the RS Online application in 2023 on Sumatra Island is categorized as good.

**Keywords:** Health Information Systems, Hospital Reporting, Health Data Quality, RS Online

## BACKGROUND

In the current digital era, technology is utilized across various fields, including the healthcare sector. One of the applications of technology in the healthcare sector is the implementation of Health Information Systems (HIS) (Chotimah, 2022). According to Government Regulation of the Republic of Indonesia Number 46 of 2014, HIS consists of a series of components, including data, information, markers, procedures, equipment, technology, and human resources (HR), which are interconnected and managed in an integrated manner (President of the Republic of Indonesia, 2014). Apart from being part of the National Health System, HIS also falls within the six core components of a country's health system, or six building blocks of health systems (World Health Organization, 2010). In another sense, HIS can also be referred to as a series of components and steps that follow a specific pattern to generate information needed in decision-making processes related to the provision of healthcare at each stage of the health system (Putri and Akbar, 2019). An integrated health information system, officially approved nationally, will serve as a platform and communication tool for reporting health programs, one of which involves the routine and systematic collection of data, ranging from the level of health service facilities to the national level (Data and Information Technology Center, 2013). One implementation of such an integrated health information system is RS Online.

RS Online is part of the Hospital Information System reporting in accordance with the Regulation of the Minister of Health of the Republic of Indonesia Number 1171 of 2011 (Minister of Health of the Republic of Indonesia, 2011). RS Online is used for routine hospital reporting and can be adjusted to the data and information needs of the Ministry of Health (Directorate General of Health Services, 2020). Data from health facilities, such as hospital reporting data on RS Online, is the primary source of data for evaluating the performance of the health sector. According to Data and Information Technology Center, the Ministry of Health in the Routine Data Quality Assessment Training Module (Data and Information Technology Center, 2023), low-quality data has varying impacts at different levels of the health system. For healthcare providers at the facility level, patient care can be disrupted if patient information is incomplete or inconsistent. For program managers, poor data quality can lead to inappropriate decisions that potentially harm the overall progress of the program and, ultimately, public health. At the planning level, poor data quality can hinder the assessment of progress to ward health sector goals and obstruct the annual planning process by providing misleading results. Additionally, when setting investments in the health sector, poor data quality can lead to the inaccurate allocation of resources.

In that module, it is explained that data quality refers to the management of data in relation to the development and implementation of activities that apply quality management techniques to the data sources (Data and Information Technology

Center, 2023). Therefore, high-quality data plays a crucial role in monitoring the progress of health indicators, such as Sustainable Development Goals (SDGs), WHO health indicators, and national as well as subnational health targets.

According to the Routine Data Quality Assessment Training Module, health data quality encompasses dimensions of uniqueness, completeness, accuracy, and validity (Data and Information Technology Center, 2023). Data quality assessment is a rapid evaluation method for the quality and adequacy of health data to be used in planning, aiming to ensure that data quality assurance becomes a systematic and routine part of health sector and program planning, as well as setting minimum quality standards for routine health data (World Health Organization, 2017). The results of data quality evaluations are expected to identify potential data quality issues and encourage follow-up actions as strategic steps in achieving national health development.

Meanwhile, based on Pusdatin's report (Data and Information Technology Center, 2013), the level of health data quality in Indonesia is still considered low. Therefore, an assessment of the quality of hospital reporting data on RS Online is necessary. The aim of this research is to evaluate the quality of routine hospital reporting data on the RS Online 2023 application for the island of Sumatra.

## II.METHOD

This study used a descriptive quantitative method with a cross-sectional design. The population in this study consisted of reporting data from 753 hospitals on Sumatra Island in 2023, which was collected through the RS Online application using total sampling. Data assessment was conducted based on the guidelines from the Routine Data Quality Assessment Module designed by the Center for Data and Information Technology of the Ministry of Health of the Republic of Indonesia in 2023. The research was conducted from March to April 2024 at the Ministry of Health of the Republic of Indonesia through the RS Online application.

## III.RESULTS AND DISCUSSION

According to the Government Regulation of the Republic of Indonesia Number 46 of 2014 on the Health Information System, health data consists of routine and non-routine data (President of the Republic of Indonesia, 2014). Routine data must be regularly collected by health service providers, local government agencies, and government institutions through recording and reporting, or other methods. An essential aim of the health information system is to generate reliable health data that underpins evidence-based policymaking (Shama et al., 2021).

According to Data and Information Technology Center (2023), high-quality data is crucial for monitoring health development priorities at both national and sub-national levels. It also plays a key role in enhancing the country's ability to prevent, prepare for, and respond to health emergencies, such as COVID-19. However, poor data quality can negatively impact situational analysis and lead to inappropriate follow-up actions (Riyanto and Purwaningrum, 2023).

Therefore, regularly reviewing data quality is a crucial element in effective managerial practices, making it an integral part of daily management needs (Prosser-Snelling and Morris, 2017). Data quality refers to the management of data related to the development and implementation of activities that apply quality management techniques to data sources (Data and Information Technology Center, 2023). Data quality assessment methods are often grounded in measurement theory (Karr, Sanil, and Banks, 2006; Batini et al., 2009;

Pipino et al., 2015; Redman, 2015). The assessment of individual routine data quality is conducted through a desk review process by measuring four dimensions of data quality: uniqueness, completeness, accuracy, and validity. Each dimension of data quality includes a set of attributes that define specific data quality requirements and provide standards for assessment (Karr, Sanil, and Banks, 2006). Different methods can be used to measure each attribute, offering flexibility in how data quality is assessed (Batini et al., 2009; Pipino et al., 2015; Redman, 2015).

In the routine hospital reporting data on the RS Online application (Secretariat of the Directorate General of Health Services, 2021), there are 28 variables, including: (1) province, (2) district/city, (3) hospital name, (4) type, (5) class, (6) ownership, (7) phone number; (8) email; (9) operational permit number, (10) operational permit date, (11) operational validity period, (12) BPJS collaboration status, (13) accreditation date, (14) accreditation status, (15) accreditation validity period, (16) number of services, (17) featured services, (18) blood bank status, (19) SIMRS status, (20) the number of human resources, (21) number of medical devices, (22) number of non-Covid beds, (23) number of non-Covid beds in use, (24) number of Covid beds, (25) number of Covid beds in use, (26) type of SIMRS vendor, (27) name of SIMRS developer, and (28) electronic medical record status.

**Table 1.** Percentage of Hospital Reporting Data Quality on RS Online Per Province in Sumatra Island 2023. Description: (1) Uniqueness, (2) Completeness, (3) Accuracy, and (4) Validity

Province	(1)	(2)	(3)	(4)
Aceh	100	93,77	99,91	99,74
Bengkulu	100	93,82	100	99,23
Jambi	100	94,47	100	100
Bangka Belitung Islands	100	94,90	100	99,29
Riau Islands	100	93,15	99,90	100
Lampung	100	95,86	99,87	100
Riau	100	97,20	99,95	99,75
West Sumatera	100	92,94	95,64	99,76
South Sumatera	100	95,57	100	99,77
North Sumatera	100	94,00	97,20	98,87
<b>Average</b>	<b>100</b>	<b>94,59</b>	<b>98,71</b>	<b>99,52</b>

### Uniqueness

In the uniqueness dimension, it is not permissible for an entity's data to be recorded more than once in one entry within a given period (Data and Information Technology Center, 2023). The threshold for this dimension is 100%, and immediate follow-up is required if one case of duplication is found. The following is the method for calculating the uniqueness dimension

$$Uniqueness = \frac{Total\ number\ of\ entries - Duplicate\ cases}{Total\ number\ of\ entries} \times 100\%$$

The uniqueness level of hospital reporting data on the RS Online application in 2023 reached 100% in all provinces in Sumatra Island. Thus, the uniqueness dimension of this data meets the predetermined threshold.

### Completeness Dimension

According to the Ministry of Health of the Republic of Uganda (2004), completeness is a crucial aspect of data quality, as missing necessary data can impede the ability to take appropriate actions. In addition, if the data is incomplete, management will find it challenging to correct it and prevent the same errors from recurring (Tristantia, 2018). In the completeness dimension, the proportion of filled data is measured against the total amount of data that should be filled (Data and Information Technology Center, 2023). Completeness was measured as the percentage of data elements that were neither blank nor unknown, representing the proportion of fully completed data elements in the facility report form (Chen *et al.*, 2014). The threshold for this dimension is categorized as less satisfactory if the percentage level is below 80%, satisfactory if the percentage level is between 80 and 90%, and good if the percentage level is above 90%. Here is the method for calculating the completeness dimension.

$$Completeness = \frac{Total\ number\ of\ mandatory\ variables\ filled}{Total\ number\ of\ all\ mandatory\ variables\ to\ be\ filled} \times 100\%$$

The completeness level of hospital reporting data on the RS Online application in 2023 reached 93.77% for Aceh Province, 93.82% for Bengkulu Province, 94.47% for Jambi Province, 95.9% for Bangka Belitung Islands Province, 93.15% for Riau Islands Province, 95.86% for Lampung Province, 97.2% for Riau Province, 92.94% for West Sumatra Province, 95.57% for South Sumatra Province, 94% for North Sumatra Province, and 94.59% for the overall average. All these values fall into the good category.

**Accuracy Dimension**

In the accuracy dimension, the variables filled in must be precise, in accordance with the actual conditions, and conform to the specified format (Data and Information Technology Center, 2023). Accurate data items are assessed for their accuracy with reference to a third-party source or other reliable source with the same chronology. The accuracy dimension is a representation of the described variable's condition. Objects or conditions can be characterized or described by data, stored as data items, records, datasets, or databases. The threshold for this dimension is categorized as less satisfactory if the percentage level is below 80%, satisfactory if the percentage level is between 80-90%, and good if the percentage level is above 90%. Here is the method for calculating the accuracy dimension.

$$Accuracy = \frac{Total\ number\ of\ mandatory\ variables\ filled\ correctly}{Total\ number\ of\ all\ mandatory\ variables\ to\ be\ filled} \times 100\%$$

In the hospital reporting data on RS Online in Sumatra Island in 2023, there are 5 variables that are incorrectly filled out out of a total of 28 variables.

**Table 2.** Number of Hospital Data Entries Not in Compliance with the Format

<b>Accuracy Variables</b>	<b>Not in Compliance with the Format</b>
Phone number	16
Operational permit date	68
Operational validity period	65
Accreditation date	62
Accreditation validity period	62

Here are the errors found in filling out hospital reporting on RS Online:

1. The Telephone Number variable can be filled in using either a landline or mobile phone number. However, there are some hospitals that entered landline phone numbers without the area code (e.g., 021 for Jakarta), which is considered not in compliance with the format.
2. The Operational Permit Date variable should be filled in with the format specified, which is yyyy-mm-dd, instead of dd-mm-yyyy.
3. The Operational Validity Period variable should be filled in with the format specified, which is yyyy-mm-dd, instead of dd-mm-yyyy.
4. The Accreditation Date variable should be filled in with the format specified, which is yyyy-mm-dd, instead of dd-mm-yyyy
5. The Accreditation Validity Period variable should be filled in with the format specified, which is yyyy-mm-dd, instead of dd-mm-yyyy.

The accuracy level of hospital reporting data on the RS Online application in 2023 reached 99.91% for Aceh Province, 100% for Bengkulu Province, 100% for Jambi Province, 100% for Bangka Belitung Islands Province, 99.9% for Riau Islands Province, 99.87% for Lampung Province, 99.95% for Riau Province, 95.64% for West Sumatra Province, 100% for South Sumatra Province, 97.2% for North Sumatra Province, and 98.71% for the overall average. All these values fall into the good category. The accuracy dimension of hospital reporting data in Sumatra Island in 2023 on RS Online meets the standards set in Government Regulation of the Republic of Indonesia Number 46 of 2014, which states that health data must be clear, accountable, and accurate.

Accurate data is crucial for presenting health information (Nurdini, 2019). According to the Regulation of the Minister of Health of the Republic of Indonesia Number 18 of 2022, health information is health data that has been processed or transformed into a form that holds value and meaning, useful for enhancing knowledge that supports health development (Menteri Kesehatan Republik Indonesia, 2022). When accurate data is processed, it produces accurate information, which is highly beneficial for decision-making, both for management and others (Setyaningrum, 2015).

**Validity Dimension**

In the validity dimension, variables must be appropriate when logical checks are performed on the data (Data and Information Technology Center, 2023). Data is considered valid if it conforms to the syntax, including format, type, range, and definition. The threshold for this dimension is categorized as less satisfactory if the percentage level is below 80%, satisfactory if the percentage level is between 80-90%, and good if the percentage level is above 90%. Here is the method for calculating the validity dimension.

$$Validity = \frac{Total\ number\ of\ variables\ that\ comply\ with\ logic}{Total\ number\ of\ variables\ considered\ in\ the\ logic}$$

To assess the validity level of data, the following 5 variables can be reviewed for compliance using logical checks.

- 1) The Operational Permit Date variable must not exceed the reporting date.
- 2) The Accreditation Date variable must not exceed the reporting date.
- 3) The Number of Services variables must not be less than 5, except for class D Pratama hospitals and hospitals that have not yet been classified.
- 4) The Number of Human Resources variable must not be less than 10, except for class D Pratama hospitals and hospitals that have not yet been classified.
- 5) The Number of Medical Devices variable must not be less than 10, except for class D Pratama hospitals and hospitals that have not yet been classified.

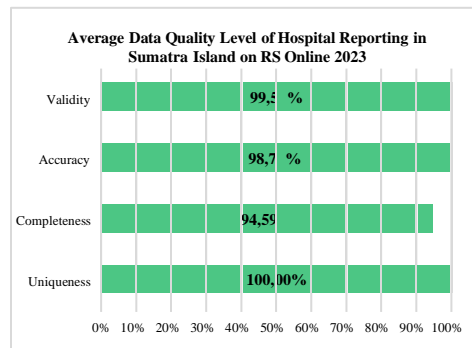
**Table 3.** Number of Hospital Data Entries Not in Compliance with Logic

Validity Variables	Not in Compliance with Logic
Operational permit date	3
Accreditation validity period	0
Number of services	5
Number of human resources	7
Number of medical devices	3

The validity level of hospital reporting data on the RS Online application in 2023 reached 99.74% for Aceh Province, 99.23% for Bengkulu Province, 100% for Jambi Province, 99.29% for Bangka Belitung Islands Province, 100% for Riau Islands Province, 100% for Lampung Province, 99.75% for Riau Province, 99.76% for West Sumatra Province, 99.77% for South Sumatra Province, 98.87% for North Sumatra Province, and 99.52% for the overall average. All of these values fall into the good category.

Overall, the quality of routine hospital reporting data on the RS Online application for Sumatra Island in 2023 falls into the good category, with percentages above 90%. The data quality is influenced by various technical, organizational, behavioral, and environmental factors (Strong, Lee and Wang, 1997; Aqil, Lippeveld and Hozumi, 2009). It encompasses extensive information systems contexts, specific knowledge, and multidisciplinary techniques (Strong, Lee and Wang, 1997; Karr, Sanil and Banks, 2006; Batini et al., 2009). In the reviewed studies, data quality is often assessed as a component of the quality effectiveness, or performance of the information system (Chen et al., 2014). In this context, the system being referred to is the RS Online application. Additionally, it may reflect the varying resources and responsibilities among institutions and individual researchers (Chen et al., 2014).

Data in the good or high-quality category is crucial for monitoring the progress of health indicators, such as the Sustainable Development Goals (SDGs), WHO health indicators, and national or subnational health targets (Data and Information Technology Center, 2023). According to the World Health Organization, high-quality data are essential for better information, improved decision-making, and enhanced population health (World Health Organization, 2008). On the contrary, if there are any mistakes, it consequently resulted in inaccurate hospital performance measurements, misallocation of health funding, and failures in public health surveillance (Cheng et al., 2009).



**Figure 1.** Average Data Quality Level of Hospital Reporting in Sumatra Island on RS Online 2023

According to source triangulation from archives and interviews with a Junior Computer Expert in the Information and Public Relations Working Team of the Secretariat of the Directorate General of Health Services, several efforts have been made by the Ministry of Health to monitor routine hospital reporting data on the RS Online application. These efforts include establishing coordination groups in each province in Indonesia with one PIC (Person in Charge) per province, conducting technical guidance activities, and regularly holding desk reviews of RS Online application reporting data as needed. These efforts are ongoing and continuously carried out with the hope that the reported data will be of high quality and beneficial to various stakeholders.

#### IV. CONCLUSIONS AND SUGGESTIONS

##### Conclusions

The uniqueness level reached an average of 100% in all provinces in Sumatra, completeness reached an average of 94.59%, accuracy reached an average of 98.71%, and validity reached an average of 99.52%. Therefore, the quality of routine hospital reporting data on the RS Online application in 2023 in Sumatra falls into the good category.

##### Recommendations

1. The Ministry of Health can routinely conduct quality assessments of aggregate health data as well as routine data, followed by monitoring and evaluation of healthcare facilities and relevant health departments.
2. The Ministry of Health also needs to maintain and enhance efforts to monitor health data by establishing coordination groups in each province in Indonesia with one Person in Charge (PIC) per province, as well as conducting technical guidance activities and regularly conducting desk reviews of RS Online application reporting data as needed.
3. Provincial Health Department and City/Regency Health Department can also participate in efforts to assess the quality of health data to obtain an overview of the health data quality at each healthcare facility. This overview can then be used as a basis for decision-making.
4. Provincial Health Department and City/Regency Health Department need to maintain and enhance efforts to monitor health data by providing reminders to healthcare facilities regarding technical guidance activities, desk reviews, as well as monitoring and evaluation activities.
5. Assessment of the quality of routine hospital reporting data on RS Online should be conducted for regions other than Sumatra Island by other researchers to obtain an overview of the quality of hospital reporting data in each region in Indonesia.
6. Assessment of data quality also needs to be carried out by other researchers on data other than hospital reporting, including individual data and aggregate data, to obtain an overview of health data quality. The results can then be useful for fellow researchers as well as policymakers.

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## REFERENCES

- Aqil, A., Lippeveld, T. and Hozumi, D. (2009) "PRISM framework: A paradigm shift for designing, strengthening and evaluating routine health information systems," *Health Policy and Planning*, 24(3), pp. 217–228. Available at: <https://doi.org/10.1093/heapol/czp010>.
- Batini, C. et al. (2009) "Methodologies for Data Quality Assessment and Improvement," *ACM Computing Surveys*, 41(3), pp. 1–52. Available at: <https://doi.org/10.1145/1541880.1541883>.
- Chen, H. et al. (2014) "A Review of Data Quality Assessment Methods for Public Health Information Systems," *International Journal of Environmental Research and Public Health*, 11(5), pp. 5170–5207. Available at: <https://doi.org/10.3390/ijerph110505170>.
- Cheng, P. et al. (2009) "The Risk and Consequences of Clinical Miscoding Due to Inadequate Medical Documentation: A case Study of The Impact on Health Services Funding," *Health Information Management Journal*, 38(1), pp. 35–46. Available at: <https://doi.org/10.1177/183335830903800105>.
- Chotimah, S.N. (2022). Implementation of the Health Information System in Indonesian Health Service Facilities: Literature Review. *Journal of Medical Record & Health Information Management*, 2(1), pp. 8–13. Available at: <https://doi.org/10.53416/jurmik.v2i1.67>.
- Directorate General of Health Services. (2020). Technical Instructions of RS Online. Jakarta: The Ministry of Health of the Republic of Indonesia.
- Karr, A.F., Sanil, A.P. and Banks, D.L. (2006). Data quality: A statistical perspective, *Statistical Methodology*, 3(2), pp. 137–173. Available at: <https://doi.org/10.1016/j.stamet.2005.08.005>.
- The Ministry of Health of the Republic of Indonesia. (2011). Regulation of the Minister of Health of the Republic of Indonesia Number 1171 of 2011 concerning Hospital Information Systems.
- The Ministry of Health of the Republic of Indonesia. (2022). Regulation of the Minister of Health of the Republic of Indonesia Number 18 of 2022 concerning Implementation of One Data in the Health Sector through the Health Information System, Ministry of Health of the Republic of Indonesia.
- The Ministry of Health of the Republic of Uganda. (2004). A Manual For Strengthening HMIS Data Quality.
- Nurdini, A. (2019). Analysis of the Quality of Patient Safety Incident Reporting Data at Wates Regional Hospital. Universitas Gadjah Mada. Available at: <https://etd.repository.ugm.ac.id/penelitian/detail/172729>.
- Pipino, L. et al. (2015). Developing Measurement Scales for Data-quality Dimensions, in R.Y. Wang et al. (eds.) *Information Quality*. New York: Routledge, pp. 37–51. Available at: <https://doi.org/doi.org/10.4324/9781315703480>.
- President of the Republic of Indonesia. (2014). Government Regulation Number 46 of 2014 concerning Health Information Systems. Available at: <http://jdih.kkp.go.id/peraturan/pp-46-2014.pdf>.
- Prosser-Snelling, E. and Morris, E. (2017) "Quality indicators," *Obstetrics, Gynaecology & Reproductive Medicine*, 27(9), pp. 290–292. Available at: <https://doi.org/10.1016/j.ogrm.2017.06.008>.
- Data and Information Technology Center. (2013). Routine Data Quality Self-Assessment Module. Jakarta: The Ministry of Health of the Republic of Indonesia.
- Data and Information Technology Center. (2023). Routine Data Quality Assessment Training Module. Jakarta: The Ministry of Health of the Republic of Indonesia.

of Health of the Republic of Indonesia.

- Putri, S.I. and Akbar, P.S. (2019). Health Information System. Ponorogo: Uwais Inspirasi Indonesia. Available at: [https://books.google.co.id/books/about/SISTEM\\_INFORMASI\\_KESEHATAN.html?id=RZyxDwAAQBAJ&redir\\_esc=y](https://books.google.co.id/books/about/SISTEM_INFORMASI_KESEHATAN.html?id=RZyxDwAAQBAJ&redir_esc=y).
- Redman, T.C. (2015). Measuring Data Accuracy: A Framework and Review, in R.Y. Wang et al. (eds.) Information Quality. New York: Routledge, pp. 21–36. Available at: <https://doi.org/doi.org/10.4324/9781315703480>.
- Riyanto, S. and Purwaningrum, D.N. (2023). Quality of Anthropometric Data Results of Electronic Community-Based Nutrition Reporting Recording in Magelang Regency. Yogyakarta: Universitas Gadjah Mada.
- Secretariat of the Directorate General of Health Services (2021). RS Online. Jakarta: The Ministry of Health of the Republic of Indonesia. Available at: <https://sirs.kemkes.go.id/fo/>.
- Setyaningrum, A. (2015). Analysis of the Patient Registration Information System Using the Pieces Method at Mulia Hati Wonogiri Hospital, Phytochemistry.
- Shama, A.T. et al. (2021). Assessment of quality of routine health information system data and associated factors among departments in public health facilities of Harari region, Ethiopia, BMC Medical Informatics and Decision Making, 21(1), pp. 1–14. Available at: <https://doi.org/10.1186/s12911-021-01651-2>.
- Strong, D.M., Lee, Y.W. and Wang, R.Y. (1997) “Data Quality in Context,” Communications of the ACM, 40(5), pp. 103–110. Available at: <https://doi.org/10.1145/253769.253804>.
- Tristantia, A.D. (2018). Evaluation of the Patient Safety Incident Reporting System in Hospitals. Journal of Indonesian Health Administration, 6(2), p. 83. Available at: <https://doi.org/10.20473/jaki.v6i2.2018.83-94>.
- World Health Organization (2008) Framework and Standards for Country Health Information Systems. 2nd ed. Italy: WHO Press. Available at: <https://doi.org/10.4018/978-1-60566-988-5>.
- World Health Organization (2010) Monitoring the Building Blocks of Health Systems: a Handbook of Indicators and. Geneva: WHO Document Production Services.
- World Health Organization (2017) Data Quality Review Module 1: Framework and Metrics, WHO Press. Available at: <http://www.who.int>.