

Comparative Health System Performance Initiative: Compendium of U.S. Health Systems, 2018, Hospital Linkage File, Technical Documentation

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U.S. Department of Health and Human Services
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www.ahrq.gov

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Prepared by:

Mathematica, Washington, DC
Laura Kimmey
Ken Peckham
David Jones
Rachel Machta
Eugene Rich

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I. Introduction

In 2015, the Agency for Healthcare Research and Quality (AHRQ) created the Comparative Health System Performance (CHSP) Initiative to study how health care systems promote evidence-based practices in delivering care.ⁱ AHRQ's goal is to understand the factors that affect health systems' use of patient-centered outcomes research (PCOR) and identify best practices in disseminating and using PCOR. To this end, the initiative established three Centers of Excellence (CoE) and a Coordinating Center to identify, classify, track, and compare health systems. AHRQ established CoEs at Dartmouth College, the National Bureau of Economic Research (NBER), and RAND Corporation.

Mathematica serves as the initiative's Coordinating Center. Mathematica is working collaboratively with AHRQ and the CoEs to facilitate synthesis of findings on comparative health system performance, build a Compendium of health system resources, and support the dissemination of the CHSP Initiative findings.

As part of the CHSP Initiative, AHRQ and Mathematica developed the Compendium of U.S. Health Systems, which resides on AHRQ's website and will be updated during the course of the initiative with additional resources to support research on health systems.ⁱⁱ The publicly available Compendium and other data resources were developed for researchers, policymakers, and other stakeholders who want to understand how health systems can improve the value of healthcare.

The Compendium includes a 2016 list of U.S. health systems, hospital linkage file, and group practice linkage file. Newly available are the 2018 list of U.S. health systems (referred to as the "list" in this document) and hospital linkage file.

AHRQ also created a file linking the 637 health systems with their member hospitals (referred to as the "hospital linkage file" in this document). The hospital linkage file includes information on 6,742 hospitals, including hospital name, street address, city, State, and ZIP Code. In addition, the file includes hospital identifiers such as the Centers for Medicare & Medicaid Services (CMS) certification number (CCN), health system name, and Compendium health system ID. The hospital linkage file is publicly available so users can identify hospitals within health systems and then, using additional data sources, examine aspects of systems and their members, such as cost and quality of care.

This document summarizes the approach taken to create the 2018 hospital linkage file. In section II, we summarize the data sources used to create the file. Section III describes the methodology used to create and refine it. In section IV, we describe the variables contained in the linkage file. The document concludes with a brief list of caveats that should be considered when using the hospital linkage file.

ⁱ Additional information on the CHSP Initiative can be found at <https://www.ahrq.gov/chsp/index.html>.

ⁱⁱ The Compendium of U.S. Health Systems, 2016, and technical documentation can be found at <https://www.ahrq.gov/chsp/Compendium/index.html>.

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II. Data Sources

Although many data sources are useful for studying health system components and their attributes, only a handful explicitly identify systems and indicate relationships among organizations that can be used to identify which collections of organizations constitute a system. These data sources include the following:

- IQVIA OneKeyⁱⁱⁱ
- AHA Annual Survey Database

We use these two data sources because they identify hospitals, link hospitals to systems, and are nationally representative. Table II.1 briefly describes each data source, including the name of the data holder, intended purpose of the data, and health system and hospital identifiers.

Table II.1. Potential data sources for health system identification

Source	Data Holder	Intended Purpose	System Identifiers	Hospital Identifiers and Hospital Count
OneKey, December 2018	IQVIA	Reference database for sales/marketing purposes	Integrated delivery network	CCN n=7,480
America Hospital Association (AHA) Annual Survey, 2017	AHA	Membership database for policy research and industry monitoring	Hospital system	AHA ID and CCN n=6,282

OneKey includes frequently updated databases that contain information on health systems, physicians, and hospitals nationwide. OneKey contains system- and facility-level data on staffing, beds, and facility type. Data are collected through a combination of telephone surveys and administrative sources. The data describe relationships that providers have with hospitals and group practices via ownership, management, leasing, purchasing, and contracting mechanisms.

AHA data are based on an annual census of hospitals. An overview of the data collection methods for OneKey and AHA can be found in the Compendium of U.S. Health Systems, 2018, Technical Documentation.^{iv}

ⁱⁱⁱ IQVIA maintains two integrated databases relevant to the study of health system performance under the umbrella of Healthcare Relational Services: OneKey Organizations, formerly known as HCOS, and OneKey Professionals, formerly known as HCPS. Throughout the document, we refer to these databases jointly as OneKey.

^{iv} Available on the Compendium web page at <https://www.ahrq.gov/chsp/data-resources/compendium.html>.

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III. Methodology

The AHA and OneKey data sources contained 6,282 and 7,480 hospitals, respectively. In this section, we first describe the hospital-to-hospital matching approach to link hospitals in AHA and OneKey to create a single set of unique hospitals. We then describe the approach to link hospitals to systems.

A. Hospital-to-Hospital Matching

We matched AHA data to OneKey to identify a set of unique hospitals across the two data sources. First, we matched hospitals using the CCN. Next, using data for hospitals in AHA and OneKey that did not match on CCN, we used the SAS COMPGED function to determine the extent to which hospital names matched. COMPGED assigns a score to each potential match, which reflects the degree to which hospital names match alphanumerically. A COMPGED score of 0 reflects an exact name match; a higher score indicates a lower quality match. Finally, we examined the geographic proximity of hospitals between the paired data sources based on geocoded street address, city, State, and ZIP Code; and exact text matches on city, State, and ZIP Code.

The name and geographic proximity matching often resulted in a one-to-many match for each pairwise comparison; for example, many AHA hospitals had multiple potential OneKey hospital matches based on name or geography. We assigned a match score to each potential match in order of the quality of the match (lower scores indicate higher quality matches), as shown in Table III.1.

All hospital pairs with a match score of 1 (CCN matches) were assessed as “matched” and set aside as matches. For the rest of the matches, we identified a best possible match using the lowest match score and closest geographic proximity. Next, for each best possible match, we visually inspected the hospitals’ names and addresses, and when necessary, conducted a web search to confirm whether the match was correct. For example, if a particular hospital in IQVIA had two matches with a match score of 3 and two matches with a match score of 4, then we visually inspected the match that had a match score of 3 and the closest geographic proximity between the two hospitals. When necessary, we conducted a web search to confirm whether the two hospitals were in fact the same hospital.

Table III.1. Match scores and descriptions

Match Score	Description
1	Exact match on CCN
2	COMPGED \leq 150 and (ZIP Codes match or street names match and hospitals are within 1 mile of each other)
3	Hospitals are within one-half mile of each other
4	COMPGED \leq 150 on full hospital name (e.g., Jones Medical Center)
5	COMPGED \leq 150 on truncated hospital name (e.g., Jones Medical)
6	Hospitals are within 10 miles of each other
7	Exact numeric match on ZIP Code
8	Exact text match on city and State

We identified 7,837 unique hospitals between the two data sources. We excluded 1,021 hospitals from the hospital linkage file that did not report a CCN or an AHA ID. We excluded them because, although they did not match any other hospitals based on name or address, without a CCN or AHA ID, we cannot be confident that they are unique hospitals. In addition, without a CCN or AHA ID, it will be difficult for users of the linkage file to confidently match these hospitals to other data sources for analysis. We then excluded 74 hospitals that were not located in one of the 50 States or the District of Columbia. These exclusions resulted in a hospital linkage file with 6,742 unique hospitals. Among those hospitals, 5,584 matched across the two data sources on the CCN. An additional 272 hospital matches were the result of matching on name and geographic proximity. Finally, 886 hospitals in the hospital linkage file did not match with a hospital from another source, based on CCN, name, or location.^v

B. Linking Hospitals to Health Systems

As described in the Compendium of U.S. Health Systems, 2018, Technical Documentation, hospitals need to be assigned to health systems for two reasons.^{vi} First, health systems contained in the Compendium are required to have at least one non-Federal general acute care hospital. Second, the list of health systems includes system attributes that are hospital-level variables aggregated to the system level, such as:

- Number of hospitals per system,
- Number of general acute care hospitals per system,
- Extent to which system hospitals are located in multiple States, and
- Number of hospital discharges per system.

Both data sources identify hospitals included in systems. Before linking hospitals to health systems, we excluded those that did not report a CCN or an AHA ID or were not located in one of the 50 States or the District of Columbia. To assign the remaining 6,742 hospitals to health systems, we applied the following rules:

1. We linked hospitals reported as being assigned to only one health system to that system.^{vii} Of the 6,742 unique hospitals with a CCN or AHA ID reported across the two data sources, 5,405 hospitals were assigned to at least one health system.^{viii} Of the 5,405 hospitals, 4,976 were assigned to one health system only, and 429 were assigned to two or more systems. The remaining 1,337 hospitals were not assigned to any health system.
2. We manually reviewed the 429 hospitals identified as being assigned to two or more health systems due to discrepancies across data sources. In most cases, the multiple systems were in fact the same system with a different name or systems nested within each

^v If a hospital had the same address and name in IQVIA and AHA data but different CCNs, we reported the IQVIA and AHA information in separate observations.

^{vi} Available at <https://www.ahrq.gov/chsp/data-resources/compendium.html>.

^{vii} Hospitals linked to one health system include those in which both data sources agree on the system assignment, as well as cases in which one or more of the data sources agree and one or more do not list the hospital in a system. For example, if one of the data sources assigns a hospital to a system, and the other data source does not assign a system for the hospital, it is listed as being in the system.

^{viii} Note, this number of hospitals is prior to excluding systems that do not meet the Compendium definition of a health system, which is discussed later in this section.

other (that is, subsystems and parent systems). In the former cases, we updated the list to indicate that these systems were a match and the hospital belonged to this system; in the latter case, we assigned the hospital to the parent system. We also identified cases in which a change in ownership occurred, which was reflected in one data source but not another. We updated these linkages to reflect the change.

3. The remaining cases were hospital-level joint ventures, in which multiple systems have a formal relationship with a hospital. In these cases, we linked the hospitals to a system using the following decision rules, in order:
 - When it was clear, based on a manual review of systems' and hospitals' websites, that one system was the majority owner or taking responsibility for running the day-to-day operations of the hospital, we linked the hospital to that system.
 - We linked the hospital to the system based on investor-owned status; that is, if the hospital was investor owned as reported in the Healthcare Cost Report Information System data, and only one of the systems was investor owned, we linked the hospital to that system.
 - In the absence of other information, we linked the hospital to the system whose headquarters location was closest to the location of the hospital; that is, we aimed to link it to a local system over regional or national systems.

After applying the exclusion criteria to remove systems that do not meet the Compendium definition of a health system and linking hospitals in subsystems to their parent systems (for a detailed description of this process, see the Compendium of U.S. Health Systems, 2018, Technical Documentation), we had 6,742 hospitals linked to the 637 systems in the Compendium of U.S. Health Systems, 2018.

The result of linking hospitals to systems is a hospital linkage file that contains one row for each hospital with a CCN or AHA ID, along with its identifying information (CCN, name, and address). In addition, if the hospital is in a Compendium system, the file includes the identifying information of its system. No hospital is linked to more than one health system.

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IV. Hospital Linkage File Contents

The hospital linkage file contains 6,742 hospitals (Table IV.1). A total of 3,887 hospitals are linked to Compendium health systems, of which 3,419 are non-Federal general acute care hospitals.^{ix} The hospital counts within the Compendium list of health systems sum to match the counts linked to systems in the hospital linkage file. An additional 2,855 hospitals contained within the hospital linkage file are not linked to a Compendium health system, and 1,346 of these are non-Federal general acute care hospitals. The remaining 1,509 hospitals are specialty hospitals, such as surgical, long-term acute care, and rehabilitation hospitals.

Table IV.1. Hospitals in the Compendium hospital linkage file

Hospital Group	N
Total hospitals in Compendium linkage file	6,742
Linked to Compendium health systems	3,887
Non-Federal general acute care hospitals	3,419
Not linked to Compendium health systems	2,855
Non-Federal general acute care hospitals	1,346

The hospital linkage file contains 12 variables, including each hospital's name; location (address, city, State, and ZIP Code); a flag for non-Federal general acute care hospitals; a unique hospital ID assigned as part of the development of the Compendium; and, if applicable, their linked Compendium health system ID, name, and location.^x

The hospital linkage file contains two linking variables. Medicare CCN (ccn) can be used to link hospitals to external data sources. The unique health system identifier (health_sys_id) can be used to link the hospital to the systems in the Compendium of U.S. Health Systems. The linkage file does not include the AHA ID, as release of this variable is not permitted under our AHA data use agreement. Appendix B contains a data dictionary for the hospital linkage file.

^{ix} See Appendix A for a description of how we identified non-Federal general acute care hospitals.

^x When hospital names or locations differed across data sources, we reported information in the hospital linkage file from AHA and OneKey, in priority order.

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V. Caveats and Limitations

This release of the hospital linkage file enables users to link Compendium health systems with their member hospitals. When using the list, users should bear in mind a few caveats and limitations to the current methods for assigning hospitals to health systems. AHRQ will continue to work closely with the CoEs, the Coordinating Center, the CHSP Technical Expert Panel, and other stakeholders to identify strategies to address these limitations in future versions of the hospital linkage file.

A. Working Definition of Health System

The Compendium definition of a health system follows:

A health system includes at least one hospital and at least one group of physicians that provides comprehensive care (including primary and specialty care) who are connected with each other and with the hospital through common ownership or joint management.^{xi}

Hospitals within health systems that do not meet this working definition are not identified in the hospital linkage file as being part of a system. Also, hospitals in the hospital linkage file are associated with parent systems; relationships between hospitals and subsystems are not identified.

B. Differences Across Data Sources

The data sources used in the development of the hospital linkage file vary in ways that affect their characterization of hospitals and their linkages to systems. The sources use different data collection methods; also, AHA data were from 2017, whereas those from OneKey were from 2018.

We attempted to maximize the coverage of hospitals in the United States by using multiple data sources. However, some hospitals may be missing from the two data sources, and thus would not be reflected in the hospital linkage file. Similarly, we used AHA and OneKey to determine whether hospitals were designated as a non-Federal general acute care hospital. However, differences in this designation across data sources may result in some general acute care hospitals not being flagged as such or vice versa (see Appendix A).

Finally, the mechanism and criteria for assigning hospitals to health systems differ by data source, which leads to differences in linkage. We encountered differences in health system assignments across data sources that we had to adjudicate. Also, we take a fairly inclusive approach, only requiring that one data source indicate a hospital is assigned to a system.

^{xi} Foundation models of health system organization are considered a form of joint management. Joint participation in an accountable care organization is not by itself indicative of joint management. In addition, “group” is not synonymous with a separately organized medical group. A hospital that employs community-based physicians who provide comprehensive care (but are not organized as a medical group) would be considered a health system.

C. Multiple Hospitals Sharing the Same CCN

The Compendium hospital linkage file does not include hospitals reporting the same CCN (for example, separate hospital facilities or campuses with different sites of care under the same parent hospital) as separate entries in the hospital linkage file; rather, the file includes a single entry for the CCN in these cases. Reporting by CCN, and thus reporting some hospitals together in a single entry in the linkage file, is a limitation for those aiming to identify all individual hospital facilities and campuses and their linkages to health systems. However, there are data sources available (for example, the AHA units file) that split some CCNs into multiple hospitals.

Users of the linkage file that have access to data that disaggregates hospitals within CCNs can use the linkage file to assign the multiple hospitals under a CCN to the correct system; for example, if CCN 111 includes hospital 222 and 333, and the CCN is in a system, hospitals 222 and 333 can be assigned to the system. This approach assumes that all hospitals under a CCN are linked to the same system.^{xii}

D. Mergers and Acquisitions

The list reflects hospitals in the United States at the end of 2018. However, because OneKey and AHA data vary in the periodicity of their updates, lags may occur in updating changes to systems and their hospitals, such as mergers, acquisitions, and name changes, that occurred before the end of 2018. Thus, the period represented by the hospital linkage file aligns with the periods covered by the data sources (2017 for AHA and 2018 for OneKey), with some level of updating accomplished through manual review of hospital-system linkages that varied by data source.

^{xii} We include hospitals with AHA IDs but missing CCNs. The hospital linkage file has 151 hospitals without CCNs but with AHA IDs. Many of the 151 (although not all) are Federal hospitals or children's specialty hospitals. It is possible these facilities do not have a CCN because they do not bill Medicare.

Appendix A. Non-Federal General Acute Care Flag

In the Compendium of U.S. Health Systems, 2018, all health systems were required to have at least one non-Federal general acute care hospital. The hospital linkage file includes a flag that identifies non-Federal general acute care hospitals—those in Compendium systems and not in systems. In this appendix, we provide additional details about the construction of the non-Federal general acute care hospital flag.

The non-Federal general acute care hospital flag in the hospital linkage file denotes hospitals that were identified as non-Federal general acute care hospitals in at least one data source (AHA or IQVIA) used to develop the Compendium of U.S. Health Systems, 2018. Table A.1 describes how non-Federal general acute care hospitals were identified in each data source.

Table A.1. Definitions of non-Federal general acute care hospitals

Data Source	Description of Non-Federal General Acute Care Hospitals
AHA	(1) Not Air Force, Army, Navy, Public Health Service, Veterans Affairs, Federal other, Indian Health Service, or Department of Justice facilities and (2) the hospital provides one or more of the following services: general medical and surgical or children's general medical and surgical care or is a critical access hospital or a major or minor teaching hospital based on resident-to-bed ratio.
IQVIA	(1) Not a government or Veterans Affairs-owned/run facility and (2) flagged as an acute care general hospital, critical access hospital, or children's hospital.

If a hospital was considered a general acute care hospital in at least one of these data sources, we flagged it as such in the hospital linkage file.

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Appendix B. Data Dictionary – Hospital Linkage File

Variable Name	Variable Type	Description
compendium_hospital_id	Character	Unique hospital ID created by the CHSP Initiative and used across all CHSP analyses ^a
ccn	Character	CMS certification number (hospital ID)
hospital_name	Character	Hospital name
hospital_street	Character	Hospital street address
hospital_city	Character	Hospital city
hospital_state	Character	Hospital State
hospital_zip	Character	Hospital ZIP Code
acutehosp_flag	Numeric	Flag for non-Federal general acute care hospitals
health_sys_id	Character	Unique Compendium health system ID (assigned by the CHSP Initiative) of the system linked to the hospital (same variable as in the Compendium of U.S. Health Systems)
health_sys_name	Character	Health system name (same variable as in the Compendium of U.S. Health Systems)
health_sys_city	Character	Health system city (same variable as in the Compendium of U.S. Health Systems)
health_sys_state	Character	Health system State (same variable as in the Compendium of U.S. Health Systems)

^a If a 2018 hospital had the same CCN and/or AHA identification number as a 2016 hospital, then we assigned the 2018 hospital the same unique hospital identification number as 2016.