Using NIST Special Publication (SP) 800-171r2/171B to assess and evaluate the Information Security posture of Technology Service Providers who support Covered Entities and/or their Business Associates in the Healthcare\textsuperscript{1} Sector.

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ABSTRACT
This paper describes how NIST Special Publication (SP) 800-171r2 (Protecting Controlled but Unclassified Information in Nonfederal Systems and Organizations) and 800-171B (Protecting Controlled but Unclassified Information in Nonfederal Systems and Organizations – Enhanced Security Requirements for Critical Programs and High Value Assets) can be used to evaluate the security posture of information systems and supporting frameworks relative to HIPAA\textsuperscript{2} and HITECH\textsuperscript{3}. It will be demonstrated that the provisions and baseline security requirements outlined in 800-171r2 and 171B for the protection of Controlled but Unclassified Information (CUI) can be applied to Electronic Protected Health Information (ePHI). An explanation of how 800-171r2 and 171B align with HIPAA and how this alignment is sufficient for evaluating the security of an IT environment which supports the healthcare sector will be detailed. The process for performing a security analysis will be described and demonstrated. Finally, the benefits of using such an approach to support other forms of risk assessment will be described.

KEYWORDS
Electronic Protected Health Information, ePHI, Security Analysis, Security Evaluation, Security Review, Risk Analysis, Risk Assessment, HIPAA, Privacy Rule, Security Rule, HITECH, Healthcare sector, HHS, NIST.

TARGET AUDIENCE
Organizations or individuals responsible for the administration, management, operations, security and maintenance of Information Technology systems and applications which hold, transfer or store Electronic Protected Health Information (ePHI). This includes both datacenter and cloud-based service providers.

Note: though specific to the health sector, this approach can be applied to any regulated industry or sector.

SCOPE
The process and procedures outlined in this paper are directed towards organizations or businesses that are responsible for providing service to, or otherwise supporting, indirectly or directly, healthcare providers, services, organizations or any other entity which handles, stores or transmits ePHI.

U.S. Critical Infrastructure Sector: Healthcare and Public Health Sector
Responsible Department: Health and Human Services (HHS)

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\textsuperscript{2} Health Insurance Portability and Accountability Act (1996)
\textsuperscript{3} Health Information Technology for Economic and Clinical Health Act (2009)
INTRODUCTION
In June, 2015 the National Institute of Standards and Technology (NIST) published Special Publication (SP) 800-171 (Protecting Controlled Unclassified Information in Nonfederal Systems and Organizations). This publication was succeeded by (SP) 800-171r1 in December, 2016 and followed by (SP) 800-171r2 and its Supplement (SP) 800-171B (Protecting Controlled Unclassified Information in Nonfederal Systems and Organizations, Enhanced Security Requirements for Critical Programs and High Value Assets) in June, 2019.

The purpose of (SP) 800-171r2 is to provide non-federal organizations with guidance for protecting the Confidentiality of unclassified (but controlled) information. As stated in its Abstract

This publication provides agencies with recommended security requirements for protecting the confidentiality of CUI when the information is resident in nonfederal systems and organizations; when the nonfederal organization is not collecting or maintaining information on behalf of a federal agency or using or operating a system on behalf of an agency; and where there are no specific safeguarding requirements for protecting the confidentiality of CUI prescribed by the authorizing law, regulation, or government-wide policy for the CUI category listed in the CUI Registry. The requirements apply to all components of nonfederal systems and organizations that process, store, or transmit CUI, or that provide security protection for such components.

Though not specifically intended for healthcare organizations the requirements contained within SP 800-171r2 are nevertheless applicable to the healthcare sector. This is due, in part, to the Department of Health and Human Services (HHS) and Office of Civil Rights (OCR) references to NIST publications in published documents and online guidance regarding cybersecurity protections and HIPAA’s Security Rule. For example, HHS-OCR, Security Risk Assessment (SRA) Tool references NIST publications in its User Guide. Moreover, vendors who develop tools (e.g., IDS, Anti-Virus, and Email protection) and companies marketing managed security services often refer NIST guidelines as “industry-standards”.

THE CHALLENGE OF THE SECURITY RULE
For healthcare providers the essential requirement of the HIPAA Security Rule is that “Covered Entities” take steps to protect the Confidentiality, Integrity and Availability (CIA) of Electronic Protected Health Information (ePHI) through Administrative, Technical and Physical (ATP) means. ATP controls address the privacy of information while CIA concerns itself with the security of information.

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4 Primarily federal contractors, or companies, agencies or organizations doing business with the federal government.
5 Confidentiality is one part of the control triad for protecting sensitive information such as Electronic Health Record(s). The other parts of the triad are Integrity and Availability. Together, they form the CIA of cybersecurity.
6 “...processing...healthcare data,” SP.800-171r2, p.1.
7 Examples include the NIST Cybersecurity Framework and (SP) 800-53r5 (Control catalog)
8 Available at The Office of the National Coordinator for Health Information Technology, Office of Civil Rights, Department of Health and Human Services (https://www.healthit.gov/topic/privacy-security-and-hipaa/security-risk-assessment-tool)
9 and Business Associates (BA)
Most clinical care providers (i.e., hospitals, clinics, medical practices, etc...) are supported by either an Information Technology (IT) department within their organization, a third-party provider, or a combination of both. Whether belonging to a ‘Covered Entity’ or ‘Business Associate’ it is the responsibility of the IT Services provider to evaluate its security posture relative to the control, protection and management of ePHI.

SECURITY EVALUATION AND RISK ANALYSIS
A requirement of the Security Rule is that Risk Analysis\textsuperscript{10} be conducted. Such analysis differs from the security evaluation outlined in SP.800-171r2/171B in the following ways:

- A security evaluation can provide a Proof-of-Compliance statement
- A security evaluation can provide a Validation-Point tool
- A Risk Analysis evaluates system vulnerabilities and security weaknesses
- A Risk Analysis evaluates Likelihood, Impact and Consequence
- A Risk Analysis evaluates Threat, Vulnerability and Expected Loss

The derived benefit of a security evaluation is that it can serve as an initial (or interim) step towards completion of formal Risk Analysis by pointing to weaknesses in an organization’s (current) security environment. Using a simple 0-1 scale to rate completion and compliance an organization can then identify weaknesses and strengths, and gauge overall effectiveness of its security framework using a defined set of common requirements.

In order to evaluate adherence to the Security Rule, healthcare providers must identify a) controls applied to systems containing ePHI and b) assess the degree at which they are performing. Such evaluation can be a difficult and challenging task given today’s diversified networks and applications.

NIST SP-800.171r2/171B PROCESS
Special Publication 800-171r2 utilizes FIPS-200\textsuperscript{11} and SP.800-53\textsuperscript{12} as the basis for its recommended Security Requirements. FIPS-200 defines the minimal security requirements for Low, Medium and High-impact information systems as outlined in FIPS-199\textsuperscript{13}. Moreover, SP.800-171r2 defines its baseline security level as being for \textit{moderate-impact} information systems. Such a level would cover any healthcare-service provider handling, transmitting or storing ePHI.

\textsuperscript{10} 45 CFR 164.308(a)(1)(ii)(a); “Conduct an accurate and thorough assessment of the potential risks and vulnerabilities to the confidentiality, integrity and availability of electronic protected health information held by the covered entity.”

\textsuperscript{11} Federal Information Processing Standards (FIPS) 200, \textit{Minimum Security Requirements for Federal Information and Information Systems}. NIST. Published March, 2006.

\textsuperscript{12} \textit{Security and Privacy Controls for Information Systems and Organizations}. NIST. Most recent version (53r5) published June, 2017.

\textsuperscript{13} Federal Information Processing Standards (FIPS) 199, \textit{Standards for Security Categorization of Federal Information and Information Systems}, NIST. Published February, 2004.
At its core, SP.800-171r2 uses compliance with 14 ‘control families’ as the basis of its one hundred twenty-one (121) questions. Control Families are groupings of security controls which address a specific security requirement. For example, Access Control deals with the methods, processes and/or procedures by which a user is granted access to ePHI. NIST SP.800-53r5 identifies twenty (20) control families. SP.800-171r2 utilizes these control families while stipulating that several, specific to the federal government, are omitted.

Table 1 shows SP.800-53r5 control families. Those highlighted in gray/bold have been omitted from the security baseline requirements of SP.800-171r2 due to their unique ‘federal’ nature. Tailoring requirements this way makes application more accurate when applied to non-government sectors such as healthcare.

| Control Family                        | Description                                      |
|---------------------------------------|--------------------------------------------------|
| Access Control                        | Personnel Security                               |
| Assessment, Authorization and Monitoring | Physical and Environmental Protection            |
| Audit and Accountability               | Planning                                         |
| Awareness and Training                 | Privacy Authorization                             |
| Configuration Management               | Program Management                                |
| Contingency Planning                   | Risk Assessment                                   |
| Identification and Authentication      | System and Services Acquisition                  |
| Incident Response                      | Security Assessment                               |
| Individual Participation              | System and Communications Protection              |
| Maintenance                            | System and Information Integrity                  |
| Media protection                       |                                                  |

Table 1

**EVALUATION PROCEDURE**

The process for utilizing SP.800-171r2 and SP.800-171B consists of a) transferring the security requirements to a medium suitable for evaluation b) answering the questions for each control family and c) computing Completion and Compliance values.

**EVALUATION PROCEDURE**

1. Import/Copy the questions, organized by Control Family, from SP.800-171r2 and SP.800-171 into Microsoft Excel (Figure 1)
2. Format to include a ‘Compliance’ column (Y/N)
3. Distinguish SP.800-171B questions thru highlighting or other formatting

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14 Control Families are security controls (applied to technology systems) which are operational, technical and management (i.e., administrative) safeguards used to protect the confidentiality, integrity and availability (CIA) of information systems.

15 NIST SP.800-53r5, *Security and Privacy Controls for Information Systems and Organizations*. Published August, 2017.

16 “...some of the security requirements expressed in the NIST standards and guidelines are uniquely federal, the requirements in this publication have been tailored for nonfederal agencies.” SP-800-171r2. p. 3.

17 Special Publication 800-71r2 cites this family as ‘Physical Protection’

18 This control family is not included in Special Publication 800-53r5

19 Excel is used as it is a common business application.
4. Create a separate spreadsheet tab for each Control Family (e.g., ACCESS CONTROL) (Figure 2)
5. Copy questions from the Control Family and format as needed
6. Include ‘Validation Point/Tool’ and Security Control (Type) columns

Repeat this process for all 14 Control Families and questions involved

7. Create COMPLETION and COMPLIANCE Summary tabs
8. For each create a computation table and radar²⁰ (aka spider) chart

PROOF OF COMPLIANCE (Statement)
There are some security assessments that require detailed explanations of policies and/or procedures in order to satisfy a particular requirement. Such detail often requires a large allocation of resources (i.e., time and staff) to complete. The approach taken here is to provide a “trimmed” answer but one which satisfies the question. For example, in Control Family ACCESS CONTROL, the question (do you) “Limit system access to authorized users, processes acting on behalf of authorized users, and devices (including other systems)”.

A simple, yet satisfactory response would be via “Role-based Access Control (RBAC)”.

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²⁰ A radar chart compares the values of three or more variables relative to a central point. It’s useful when you cannot directly compare the variables and is especially great for visualizing performance analysis or survey data.
VALIDATION POINT/TOOL
This value denotes what specific application, utility, or process is used to satisfy the security requirement. Often, the same tool is used to satisfy several security requirements (example an IDS\textsuperscript{21} and VPN for remote access security).

SECURITY CONTROL/TABLE
This value directly references HIPAA’s Security Rule which requires security controls to be categorized as Administrative, Technical or Physical. Most often, a security control has only a single categorization but there are instances where a control may encompass more than one. For example, establishing an operational incident-handling capability may be categorized as both an Administrative and Technical control.

COMPLETION AND COMPLIANCE
In the context of a security assessment, completion can be defined as the extent to which all questions have been answered (i.e., either they have or haven’t). Given the number of questions in the assessment\textsuperscript{22} tracking completion aids in organizing and gauging progress, especially if the assessment is completed by more than one person.

Compliance is defined as the extent an organization’s security ‘posture’ is aligned with the requirements of SP.800-171r2/171B. Its use establishes whether or not, for a given question, the security control maps to the requirement. Responses include Yes, Alternative Method (we do it but differently), Partial (we do it but not fully), No and Does Not Apply. Each answer has an assigned numeric value between 0-1. Individual values are totaled (both as Control Family and Aggregate) then compared against a maximum value. The resulting value is the level of compliance with NIST recommendations.

A radar chart provides a graphical depiction (imagine looking down at the top of an umbrella) of each Control Family’s value for both Completion (Chart 1) and Compliance (Chart 2). It is an easy and general way to view deficiencies and gaps which need to be completed or addressed.

Ideally, the Completion table should achieve 100% completion with acceptable compliance being a value that is determined by the company or organization. In other words, some organizations may find 70% compliance acceptable while others may strive for 80% or better. Regardless of threshold, compliance provides an organization with an idea of how well its security posture compares to established, recommended standards.

\textsuperscript{21} Intrusion Detection System (IDS)
\textsuperscript{22} SP.800-171r2 (moderate security) has 121 questions and SP.800-171r2+171B has 155 questions
Chart 1 (Completion Summary)

Chart 2 (Compliance Summary)
**BENEFITS OF USING NIST SP.800-171r2/171B FOR SECURITY EVALUATION**

1. SP.171r2 & 171B can be used to assess an organization’s information security posture in alignment with HIPAA requirements.
2. The derived security requirements outlined in NIST SP.800-171r2 and 171B omit security controls exclusive to federal information systems.
3. Utilizing the assessment approach in SP.171r2 suggests an evaluation methodology that is adaptable to the non-federal sector.
4. Areas of weakness identified in a security assessment can be used, in part, as the basis for formal risk assessment.
5. Easy to use and employs industry Best-Practices and guidance.

**CONCLUSION**

Healthcare providers (i.e., Covered Entities) are mandated by HIPAA and HITECH to protect the Confidentiality, Integrity and Availability (CIA) of Electronic Protected Health Information (ePHI). This requirement extends to technology providers and Business Associates (BA) which directly support the (healthcare) provider.

NIST SP.800-171r2 and its supplement SP.800-171B can be used to evaluate an organization’s security posture relative to data protection. Moreover, each provides a different level of security for evaluation; SP.800-171r2 for Medium-security systems and SP.171B for Critical Programs and High Value Assets. In addition, since the approach of these publications differs from other NIST publications (in that the emphasis is on protecting information in non-federal information systems) it can be mapped to other regulated industries and sectors.

This paper has outlined how NIST publications can be used to evaluate a healthcare provider’s information security environment by assessing the levels of Completion and Compliance using the Control Family requirements listed in SP.800-171r2/171B. Compliance provides “situational awareness” for how well an organization’s security posture aligns with industry standards and best practices.

Finally, SP.800-171r2/171B can be used to create a documented history of compliance. Such history can serve as a dynamic guide for an organization in making decisions for improvements to its information security environment.
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