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January 30, 2012

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Associate Director, Moores Cancer Center Administration
0658

Subject: ***Cancer Center Data Security – Phase II, Moores Cancer Center Audit Project 2012-26A***

The final audit report for the Cancer Center Data Security – Phase II, Audit Report 2012-26A, is attached. We would like to thank you and your Information Technology team for the cooperation and assistance we received during the audit.

Because we were able to reach agreement regarding corrective actions to be taken in response to the audit recommendations, a formal response to the report is not requested.

The findings included in this report will be added to our follow-up system. We will contact you at the appropriate time to evaluate the status of the corrective actions. At that time, we may need to perform additional audit procedures to validate that actions have been taken prior to closing the audit findings.

UC wide policy requires that all draft audit reports, both printed and electronic, be destroyed after the final report is issued. Because draft reports can contain sensitive information, please either return these documents to AMAS personnel, or destroy them. AMAS also requests that draft reports not be photocopied or otherwise redistributed.

Stephanie Burke
Assistant Vice Chancellor
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Attachment

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AUDIT & MANAGEMENT ADVISORY SERVICES

Cancer Center Data Security – Phase II
Moores Cancer Center Administration
January 2012

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Project Number: 2012-26A

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I. Background

Audit & Management Advisory Services (AMAS) has completed a review of the data security processes and technologies implemented by the Moores Cancer Center (MCC) Information Technology (IT), which is the unit that supports MCC administrative and research computing. This report provides the results of our review.

The Moores Cancer Center (MCC) is one of five UCSD School of Medicine (SOM) Organized Research Units (ORUs). Established in 1979, the MCC is one of 40 National Cancer Institute (NCI) designated Comprehensive Cancer Centers in the United States. MCC research laboratories and clinic facilities support clinical and non-clinical cancer related research projects, cancer prevention and outreach programs, and comprehensive clinical care.

The MCC network connects to the UCSD campus backbone network, and is managed by the following five full and part time employees (FTE) in coordination with campus Administrative Computing and Telecommunications (ACT) and UCSD Health System Information Services personnel:

- IT Director/Database and Application Developer, 1 FTE
- Database and Application Developer, 1 FTE
- Systems Administrator, 1FTE
- Desktop and AV support, 1FTE
- Desktop Support, 0.5 FTE

The network consists of nine servers and approximately 1,000 workstations. Much of the data that is processed by and stored on the MCC network is highly sensitive personally identifiable information (PII) or protected health information (PHI). Security over this type of information is critical to protect against damage or loss of technology or data that would impact MCC's ability to provide research and/or patient services, and to ensure compliance with Federal and State laws, and University policies.

Departments that manage sensitive data must be focused on ensuring that network security is adequate to comply with applicable regulations. PII is subject to the provisions of California State Bill 1386. Systems that store PHI are subject to Health Insurance Portability and Accountability Act (HIPAA) privacy and security requirements.

In addition to legislative requirements, MCC computer equipment must also conform to University of California (UC) Business and Finance Bulletin IS-3 (IS3), *Electronic Information and Security Policy;* and UCSD Policy and Procedure Manual 135-3 (PPM 135-3), *Network Security*; and PPM 135-3 Exhibit C: *Minimum Network Connection Standards* (Minimum Standards). IS3 establishes guidelines for achieving appropriate protection for University electronic resources and identifying roles and responsibilities at all levels in the University of California system. PPM 153-3 Exhibit C standards provide

minimal security requirements for devices that are connected to the UCSD Campus network backbone.

In May 2011, AMAS completed a preliminary network security risk assessment of the MCC network based on elements of IS3, PPM 135-3 and the Minimum Standards. The risk assessment results were compiled using information obtained through analyzing responses to a Computer Environment Internal Control Questionnaire (ICQ) and supporting documentation, and conducting follow-up interviews with MCC network management personnel. Based on those procedures, we determined that a focused review should be performed for selected areas to verify that certain network security controls were in place and performing as expected.

II. Audit Objective, Scope, and Procedures

Based on the preliminary risk assessment performed, the objectives of our review were to determine whether processes and technologies implemented to secure IT resources, and the sensitive data stored on MCC clinical workstations and servers were adequate to minimize the risk of unauthorized access or data loss; and to validate that standard security measures implemented were functioning as designed.

We completed the following audit procedures to achieve project objectives:

- Reviewed PPM135-3, Minimum Standards, and IS3;
- Interviewed the MCC IT Director and Systems Administrator to further assess areas of risk;
- Analyzed the Access Control Lists (ACL's) that restrict network data traffic to and from MCC networked resources (workstations and servers);
- Evaluated host-based firewall rules that control incoming and outgoing data traffic to workstations and servers;
- Assessed workstation and server configurations for logging requirements and host registration information;
- Performed network vulnerability scanning using Retina on files servers and workstations and evaluated reported vulnerabilities; and,
- Completed an information security review assessment based on elements of IS3, PPM 135-3 and the Minimum Standards (***Attachment A***).

MCC network printers were excluded from the scope of the vulnerability scans to ensure that printing services were not disrupted.

III. Conclusion

Based on our review procedures, we concluded that network security practices appeared generally adequate to ensure the confidentiality, integrity and availability of essential or restricted information system resources and data. However, network vulnerability scans performed during this review identified areas of risk involving systems and application security on servers and workstations. In addition, we noted some areas where activities were not in strict compliance with policy requirements including minimum standards; application systems management; risk assessment activities; and information security planning.

IV. Observations and Management Corrective Actions

A. Systems and Application Security

Vulnerability scans completed on MCC network servers and workstations identified system vulnerabilities, and a number of open ports on network devices.

One of the primary risks to network hardware and data is the potential exploitation of system vulnerabilities[1]. In order to reduce the risk that a vulnerability will be exploited, IS security personnel frequently apply updates and patches to software, and limit the number of services that are running on a device to only those that are necessary to achieve business objectives. Limiting the number of services that run on a device also decreases the number of open ports on network devices, thereby reducing the risk that future vulnerabilities will be exploited.

UCSD Minimum Standards include several policies that address limiting the number and type of device services that are running, and addressing system vulnerabilities. Section 2.2 states that campus networked devices must run software in which security patches are available and applied in a timely manner. Section 2.4 requires that devices only run services necessary for the intended purpose of the device. Section 6.2.3, which is applicable only to servers that process sensitive information, requires that patches be applied within a week of availability. Section 6.2.5, which was to be implemented by January 1, 2009, requires that departments use a single server to support a single purpose, and to limit the number of services running on servers.

AMAS completed network vulnerability scans on computing devices administered by MCC IT using the Retina Network Security Scanner to identify existing vulnerabilities, and ports that were open on servers and workstations.

[1] A system vulnerability is a weakness which allows an attacker to reduce a system's information assurance. A vulnerability reflects the intersection of three elements: a system susceptibility or flaw, attacker access to the flaw, and attacker capability to exploit the flaw.

Credentialed and non-credentialed scans were performed on selected servers and workstations at both locations. Credentialed scanning allows a detailed view of software patch levels, and high level system configurations. Non-Credentialed scanning provides the same view of the network that is seen by an individual without network permissions. The results of the Retina scans were provided to MCC IT personnel under separate cover.

The scans identified a number of vulnerabilities on department servers; two of which contained sensitive information. In addition, the network scans identified open ports on the majority of department servers and workstations. Some of the open ports were running unknown services, which should be reviewed to determine their business use, and to verify that malicious software such as rootkits[2], and Trojans[3] are not installed. These types of programs have typically been used to launch denial of service attacks, to launch further attacks against other campus systems, and to facilitate the sharing of inappropriate data. All unnecessary services should be identified and stopped, and any associated ports should be blocked.

Management Corrective Actions:

MCC IT will:

1. Evaluate the results of the Retina scans and address all high and medium risk vulnerabilities that are not deemed to be false positives. MCC IT advised AMAS that they have remediated the high and medium risk vulnerabilities noted in the original scans for all of the servers. Follow up vulnerability scans will be completed to validate the remediation results.

2. Review open port lists, and close all ports that are not necessary to support business operations.

B. Minimum Standards Compliance

MCC IT was not in strict compliance with Minimum Standards with regard to system audit logging, firewall configuration and internet protocol (IP) host registration.

The UCSD Minimum Standards are intended to reduce the risk that UCSD computing equipment and data are compromised. Computing equipment not

[2] A rootkit is software that enables continued privileged access to a computer while actively hiding its presence from administrators by subverting standard operating system functionality or other applications.
[3] A Trojan horse, or Trojan, is software that appears to perform a desirable function for the user prior to run or install, but which, sometimes in addition to the expected function, steals information or harms the system.

meeting the standards represents a significant potential security threat, which could result in significant costs when security breaches occur.

1. Audit Logging

   Most components of an IT infrastructure are capable of producing logs to capture their activity over time. The logs often contain very detailed information about the activities of applications and the layers of software and hardware that support them. With proper management, device activity logs can enhance security, system performance and resource management when used to perform the following functions:

   - Monitor access controls;
   - Reconstruct security incidents; and
   - Achieve regulatory compliance.

   Minimum Standards for workstations and servers that participate in sensitive activity, section 5.2.4 and 6.2.4, require logging which identifies the user, type of event, date and time with time zone, success or failure, and origin of event, and must identify system component, affected data, or resource. In addition, logs should be archived at least weekly to a central log server for storage. During the review, we noted that MCC IT had proper logging parameters enabled for workstations and servers that participate in processing of sensitive information. However a log archive process was not in place per Minimum Standards requirements.

   Management Correction Action:

   MCC IT has implemented a log archiving process for servers. A similar process for workstations that process sensitive information will be evaluated and implemented as appropriate.

2. Firewall Software Configuration

   Minimum Standards for workstations and servers that participate in sensitive activity, section 5.2.1 and 6.2.1 require that host-based firewall software be configured to allow communication only from necessary workstations and required services. We performed a detailed review of network and host access control lists and identified a weakness with regard to vendor access to support a clinical trial application. Open access was allowed from a machine at the vendor's office into the MCC server vlan network, attaching directly to a clinical trials application server. Because the security posture of the vendor machine is not known and cannot be confirmed at any given point, sensitive data residing on the server could be exposed to unauthorized access. In addition, server access control list's and corresponding network firewall

configuration statements did not aligned to provide adequate protection between public facing servers and protected servers.

Management Corrective Actions:

MCC IT has reviewed communication access to and from all workstations and servers that participate in sensitive activity. Vendor access has been restricted to only those ports and services necessary for support. Server access control list's and corresponding network firewall configurations have been modified to provide enhanced protection between public facing servers and protected servers.

3. IP Host Registration

Minimum Standards for workstations and servers that connect to the campus data communications network, section 2.1 require that all devices must be registered with Administrative Computing and Telecommunications via the UCSD Hostmaster. In addition, registration information must be reviewed periodically and updated as needed. We reviewed a listing of MCC servers with the Hostmaster database and noted that several servers with phi did not reflect the proper location information and in some instances the registration did not list the sensitive data. In July of 2010, ACT modified the host registration form to gather information regarding the type of data that will be hosted on the connecting device. This information is used to identify high risk machines as well as assess the need for access.

Management Corrective Action:

MCC IT has reviewed and updated host registration details to provide complete and accurate information to include those devices that contain sensitive information.

C. Application Systems Management

MCC IT administered web server applications; however, a formal change management process had not been implemented to document application changes.

A formal change management process is an important best practice for departments or units that make changes to internally or externally developed software or applications to ensure all program changes are authorized and controlled. The objectives of a change management process are to ensure that all changes to production applications are appropriately authorized, documented and

tested to reduce the likelihood that computing processes are disrupted due to programming errors resulting from incorrect or unauthorized application changes.

A typical change management process requires that IT programmers document, at a minimum: the reason for application changes; the impact on users, testing procedures and results; management's approval; and a plan for post implementation monitoring. A well developed change management process will also include the procedures used to make emergency changes to applications. In addition, change management processes generally require a segregation of duties between programmers responsible for making changes to applications and programmers responsible for migrating changes into the production environment.

IS-3 states that maintaining system integrity requires that all changes to a system are conducted according to a planned and supervised change management process. In particular, changes to any *restricted* or *essential* resource shall be performed according to authorized change management procedures that ensure the recording of all changes. Change management procedures should include:

- monitoring and logging of all changes;
- steps to detect unauthorized changes;
- confirmation of testing;
- authorization for moving application programs to production;
- tracking movement of hardware and other infrastructure components;
- periodic review of logs;
- back out plans; and,
- user training.

During the review, AMAS was made aware that MCC IT had segregated programming duties between the two Application Developers. Currently, one Developer develops the code in the test environment, the second Developer runs tests, and the original Developer moves the new code into the production environment, as appropriate. However, a formal change management process was not in place. This audit finding was also noted in AMAS project *School of Medicine Distributed Network Security, Phase II* # 2009-29. According to MCC IT, department applications have not required significant changes in the recent past, and no significant changes are foreseen in the near future. Nonetheless, the lack of a formal change management process increases the risk that unauthorized changes, or changes not adequately tested, could be migrated into the production environment.

Management Corrective Action:

MCC IT will adopt the standards to aid in the development of a formal change management process. At a minimum, the standards

will include: the reason for application changes; the impact on users, testing procedures and results; management's approval; and a plan for post implementation monitoring. In the event that IT staffing is insufficient to implement proper segregation of duties, an alternative mitigating control will be implemented.

D. Risk Assessment

MCC IT would benefit from a comprehensive risk assessment to identify and classify information assets and identify potential risks.

The purpose of a risk assessment is to help management create appropriate strategies and controls for stewardship of information assets. Departments or units that manage information assets and electronic resources should conduct formal risk assessments to determine the level of protection needed to adequately protect various existing information resources, and to understand and document potential risks from IT security failures that may cause loss of information confidentiality, integrity, or availability. As business operations, workflow, or technologies change, periodic reviews should be conducted to analyze these changes, to account for new threats and vulnerabilities created by these changes, and to determine the effectiveness of existing controls.

UCOP provides general guidelines for developing a risk assessment, which include:

- Identify assets covered by the assessment
- Categorize potential losses
- Identify threats and vulnerabilities
- Identify existing controls
- Analyze the data
- Determine cost-effective safeguards
- Report to Management

During the review, we noted that MCC IT did not employ a comprehensive risk assessment process. MCC IT was able to provide detailed information regarding the systems that they managed; however, specific risks and a level of security necessary to protect those resources were not identified and formally documented.

Management Corrective Action:

MCC IT and Management will perform a comprehensive risk assessment to identify primary security objectives for protecting information resources. The risk assessment will include classification of the information assets stored on the devices or within the applications and identify the level of security necessary

to protect the information resources. Additional Risk Assessment resources are included in ***Attachment B***.

E. Information Security Plan

MCC IT would benefit from a documented security plan to enhance the security of information assets.

An information security plan should be developed that takes into consideration the acceptable level of risk for systems and processes. A security plan should account for the management, use, and protection of confidential information; and identify the procedures and controls that are needed to enhance security for information assets. It should also identify cost-effective strategies to be implemented to mitigate the risks that are consistent with organizational goals and business functions. The security plan should be developed at the completion of the risk assessment process. Because MCC IT had not performed a comprehensive risk assessment, the security plan to consider acceptable risk levels and proper mitigation was not in place.

Management Corrective Action:

MCC IT and Management will develop an information security plan that identifies acceptable levels of risk for information assets, systems and processes.

Assessment Categories	Objective	Risk Assessment
Management Measures: People		
1. Security Education and Awareness Training	Assess employee's awareness of System-wide Security policies.	No Reportable Observations
Technical Measures		
2. Identity and Access Management	Assess the technical measures for controlling authentication and authorization (password policy, access rights/roles).	No Reportable Observations
3. Access Controls to Authenticate and Authorize Users	Assess the controls for session protection, automatic logout, and procedures for managing privileged accounts.	No Reportable Observations
4. Systems and Application Security	Assess the procedures in place for systems responsibilities including separation of duties; backup and retention efforts; and patch management practices.	**See Report Observation A**
9. Network Security Tools and Practices	Assess the network security strategies and technical security measures (Minimum Standards for Network Connectivity).	**See Report Observation B**
5. Application Systems Management	Assess the process for application version control and migration practices from development to quality assurance to the production environment. Assess the change management practices for software development and configuration.	**See Report Observation C**
6. Collection, Management and Analysis of Log Data	Assess the audit log infrastructure and review practices.	No Reportable Observations
7. Data Protection and Encryption	Assess the use of encryption for data in transit and data at rest.	No Reportable Observations
8. Risk Mitigation Measures	Assess the process for prevention, detection, and recovery from emergency conditions.	No Reportable Observations

Assessment Categories	Objective	Risk Assessment
Management Measures: Processes		
10. Asset Inventory and Classification	Assess the process for identifying electronic information resources.	No Reportable Observations
11. Risk Assessment	Assess the process to understand and document the risks in the event of failures that may cause loss of confidentiality, integrity, or availability of information resources. Identify the level of security necessary for the protection of the resources	**See Report Observation D**
12. Information Security Plan	Assess the departments documented process for accepting a level of risk for systems and processes, and that procedures and controls in place will enhance the security of information assets.	**See Report Observation E**
13. Workforce Administration	Assess the protection for granting and/or revoking authorizing and protecting access to information systems.	No Reportable Observations
14. Physical/Environmental Controls	Assess the procedures for physical protection of resources that support restricted or essential systems and/or data.	No Reportable Observations
15. Incident Response Planning and Notification Procedures	Assess the process for reporting and handling a security incident	No Reportable Observations

Risk Assessment Methodology Overview [1]

Many different approaches to risk assessment have been developed. These following guidelines provide a simple step-by-step process. Additional resources and methodologies are linked under Resources to help you establish an approach appropriate to your business environment.

General Guidelines for a Risk Assessment

1. **Establish the risk assessment team**. The risk assessment team will be responsible for the collection, analysis, and reporting of the assessment results to management. It is important that all aspects of the activity work flow be represented on the team, including human resources, administrative processes, automated systems, and physical security.
2. **Set the scope of the project.** The assessment team should identify at the outset the objective of the assessment project, department, or functional area to be assessed, the responsibilities of the members of the team, the personnel to be interviewed, the standards to be used, documentation to be reviewed, and operations to be observed.
3. **Identify assets covered by the assessment**. Assets may include, but are not limited to, personnel, hardware, software, data (including classification of sensitivity and criticality), facilities, and current controls that safeguard those assets. It is key to identify all assets associated with the assessment project determined in the scope.
4. **Categorize potential losses**. Identify the losses that could result from any type of damage to an asset. Losses may result from physical damage, denial of service, modification, unauthorized access, or disclosure. Losses may be intangible, such as the loss of the organizations' credibility.
5. **Identify threats and vulnerabilities**. A threat is an event, process, activity, or action that exploits a vulnerability to attack an asset. Include natural threats, accidental threats, human accidental threats, and human malicious threats. These could include power failure, biological contamination or hazardous chemical spills, acts of nature, or hardware/software failure, data destruction or loss of integrity, sabotage, or theft or vandalism. A vulnerability is a weakness which a threat will exploit to attack the assets. Vulnerabilities can be identified by addressing the following in your data collection process: physical security, environment, system security, communications security, personnel security, plans, policies, procedures, management, support, etc.
6. **Identify existing controls**. Controls are safeguards that reduce the probability that a threat will exploit a vulnerability to successfully attack an asset. Identify those safeguards that are currently implemented, and determine their effectiveness in the context of the current analysis.
7. **Analyze the data**. In this phase, all the collected information will be used to determine the actual risks to the assets under consideration. A technique to analyze data includes preparing a list of assets and showing corresponding threats, type of loss, and

[1] Risk Assessment Methodology gathered from UCOP website

vulnerability. Analysis of this data should include an assessment of the possible frequency of the potential loss.

8. **Determine cost-effective safeguards**. Include in this assessment the implementation cost of the safeguard, the annual cost to operate the safeguard, and the life cycle of the safeguard.
9. **Report**. The type of report to make depends on the audience to whom it is submitted. Typically, a simple report that is easy to read, and supported by detailed analysis, is more easily understood by individuals who may not be familiar with your organization. The report should include findings; a list of assets, threats, and vulnerabilities; a risk determination, recommended safeguards, and a cost benefit analysis.

Additional Resources:

Departmental Security Review and Planning

http://www.ucop.edu/irc/itsec/securityreview.html

BFB IS-2 Inventory, Classification, and Release of University Electronic Information

http://www.ucop.edu/ucophome/policies/bfb/is2.pdf

Risk Assessment Resources

http://www.ucop.edu/irc/itsec/riskresources.html