



June 2022

ELECTRONIC HEALTH RECORDS

Additional DOD Actions Could Improve Cost and Schedule Estimating for New System

Accessible Version

Why GAO Did This Study

DOD operates one of the nation's largest health care systems providing health care to about 9.6 million beneficiaries. It relies on multiple legacy electronic health record systems to create, maintain, and manage patient health information. DOD determined that these systems, implemented over the past three decades, require modernization and replacement with a comprehensive, real-time electronic health record, MHS GENESIS.

Congress included a provision in the Joint Explanatory Statement accompanying the *Consolidated Appropriations Act, 2021* for GAO to review DOD's deployment of MHS GENESIS. This report determines the extent to which DOD's MHS GENESIS's cost estimate and program schedule are consistent with best practices. GAO reviewed documentation supporting the program's October 2020 cost estimate against best practices. In addition, GAO reviewed the program's February 2021 integrated master schedule, specifically assessing three subproject schedules. Further, GAO interviewed DOD officials within the program office to understand their practices for developing and maintaining the cost estimate and program schedule.

What GAO Recommends

GAO is making two recommendations to DOD that it develop reliable cost and schedule estimates for the MHS GENESIS program that are consistent with GAO-identified best practices. DOD concurred with GAO's recommendations.

View [GAO-22-104521](#). For more information, contact Carol C. Harris at (202) 512-4456 or harriscc@gao.gov

ELECTRONIC HEALTH RECORDS

Additional DOD Actions Could Improve Cost and Schedule Estimating for New System

What GAO Found

The Department of Defense (DOD) began deploying Military Health System (MHS) GENESIS—a commercial electronic health record system intended to integrate inpatient and outpatient medical and dental information in 2017. MHS GENESIS's contract award totals \$5.5 billion. DOD's plans call for implementing MHS GENESIS in 24 waves or phases. The first wave was completed in October 2017 with the last wave expected to be deployed by December 2023 and additional activities planned through 2025.

DOD has not fully met the characteristics and associated best practices for developing MHS GENESIS cost and schedule estimates, as shown below.

Cost estimate characteristic	Assessment of cost estimate	Schedule estimate characteristic	Assessment of schedule estimate
Comprehensive	Substantially met	Comprehensive	Substantially met
Well-documented	Partially met	Well-constructed	Partially met
Accurate	Substantially met	Credible	Partially met
Credible	Minimally met	Controlled	Substantially met

Legend: substantially met = DOD provided evidence that satisfies a large portion of the criterion; partially met = DOD provided evidence that satisfies about one-half of the criterion; minimally met = DOD provided evidence that satisfies a small portion of the criterion

Source: GAO assessment of the Department of Defense (DOD) Military Health System GENESIS program documentation. | GAO-22-104521

MHS GENESIS's cost estimate was unreliable because it did not substantially meet all four characteristics of a reliable cost estimate, as described in GAO's cost guide. Specifically, DOD minimally met the "credible" characteristic associated with reliable cost estimates, in part, because it did not provide evidence that a sensitivity analysis, a risk and uncertainty analysis, or an independent cost estimate were conducted. Reliable cost estimates are critical for successfully delivering IT programs.

In addition, the subproject schedules did not meet all four characteristics of a high quality, reliable schedule. Because an integrated master schedule consolidates subproject schedules, errors and reliability issues in subproject schedules will be reflected in higher-level schedules. Therefore, the larger master schedule is unreliable. Specifically, the subproject schedules partially met the "well-constructed" characteristic associated with reliable schedule estimates, in part because their critical paths could not be validated or they exhibited total float values that could allow activities and milestones to slip months or years before delaying key program activities. A reliable schedule can assist with the systematic execution of a program and the means by which to gauge progress, identify and address potential problems, and promote accountability.

Because the MHS GENESIS program cost and schedule estimates were not reliable, DOD increases the risk that management will not have the information necessary for effective decision-making. Following cost and schedule best practices can help minimize the risk of cost overruns and schedule delays, and would better position DOD for successful program implementation.

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Abbreviations

CARD	cost analysis requirements description
DOD	Department of Defense
ICE	independent cost estimate
IMS	integrated master schedule
MHS	Military Health System
OMB	Office of Management and Budget
SRA	schedule risk analysis
VA	Department of Veterans Affairs
WBS	work breakdown structure

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June 8, 2022

The Honorable Jon Tester
Chair
The Honorable Richard Shelby
Ranking Member
Subcommittee on Defense
Committee on Appropriations
United States Senate

The Honorable Betty McCollum
Chair
The Honorable Ken Calvert
Ranking Member
Subcommittee on Defense
Committee on Appropriations
House of Representatives

The Department of Defense (DOD) operates the Military Health System (MHS), one of the nation's largest health care systems providing health care to about 9.6 million beneficiaries, including service members, retirees, and their family members. MHS provides care to beneficiaries at more than 700 military hospitals and clinics (i.e., military treatment facilities) around the world.

DOD relies on multiple legacy electronic health record systems to create, maintain, and manage patient health information.¹ The department has determined that these systems, implemented over the past three decades, require modernization and replacement with a comprehensive, real-time electronic health record system.

In 2013, the Secretary of Defense chartered the Program Executive Office of the Defense Healthcare Management Systems (program office) to improve the health care of DOD's beneficiaries by modernizing the electronic health record systems and establishing medical data sharing among DOD, the Department of Veterans Affairs (VA), and the private sector. Toward this end, in 2017 DOD began deploying MHS GENESIS—

¹An electronic health record is a collection of information about the health of an individual and the care provided to that individual, such as patient demographics, progress notes, problems, medications, vital signs, past medical history, immunizations, laboratory data, and radiology reports.

a new electronic health record system intended to integrate inpatient and outpatient medical and dental information.

The Joint Explanatory Statement accompanying the Consolidated Appropriations Act, 2021 included a provision for GAO to review DOD's deployment of MHS GENESIS.² Our objective for this review was to determine to what extent DOD's MHS GENESIS's cost estimate and program schedule are consistent with cost estimating and schedule assessment best practices.

To address the objective, we evaluated documentation supporting the program's October 2020 cost estimate against the best practices for developing a comprehensive, accurate, well-documented, and credible cost estimate identified in GAO's Cost Estimating and Assessment Guide.³ Additionally, we reviewed the MHS GENESIS integrated master schedule (IMS),⁴ dated February 2021, and related supporting documentation against the best practices for developing a comprehensive, well-constructed, credible, and controlled schedule identified in GAO's Schedule Assessment Guide.⁵

The IMS is detailed and highly complex due to the large number of integrated subprojects and activities. Because an IMS consolidates subproject schedules, errors and reliability issues in subproject schedules will be reflected in higher-level schedules. As such, we based our schedule evaluation on an assessment of three subprojects within the schedule.⁶ The subprojects we assessed were selected based on whether they included a significant and varying number of discrete activities in the project schedule and were currently on-going. The three

²Joint Explanatory Statement, accompanying Consolidated Appropriations Act, 2021, Pub. L. No. 116-260, H Comm. Print, Book 1 of 2, Div. C at p. 702 (March 2021).

³GAO, *Cost Estimating and Assessment Guide: Best Practices for Developing and Managing Program Costs*, [GAO-20-195G](#) (Washington, D.C.: March 2020).

⁴An integrated master schedule connects all the scheduled work of the government and the contractor in a network, or collection of logically linked sequences of activities. As a document that integrates the planned work, the resources necessary to accomplish that work, and the associated budget, it should be the focal point of program management.

⁵GAO, *Schedule Assessment Guide: Best Practices for Project Schedules*, [GAO-16-89G](#) (Washington, D.C.: December 2015).

⁶The reliability of an integrated master schedule depends in part on the reliability of its subordinate schedules—weaknesses in these schedules will be reflected in the overall schedule for the program effort.

subprojects represent approximately 20 percent of the remaining activities in the IMS. The subprojects are Apple Product Improvement Engineering (subproject 1), Stage 6 (subproject 2), and Elderberry Product Improvement Engineering (subproject 3).

Assessing three subprojects limits possible statements about the program's entire schedule. For example, if the program is not following best practices in creating and maintaining the three subproject schedules, we can conclude that the larger integrated schedule is unreliable. However, if the selected subprojects are deemed reliable, we cannot definitively determine the reliability of the integrated master schedule because the other subprojects that were not assessed may be unreliable.

In addition, we interviewed DOD officials within the program office to understand their practices for developing and maintaining the cost estimate and program schedule. Further, we provided DOD with draft versions of our detailed analyses of the MHS GENESIS cost estimate and schedule and asked DOD officials to verify the information on which we based our findings. Appendix I provides additional details on our scope and methodology.

We conducted this performance audit from September 2020 to June 2022 in accordance with generally accepted government auditing standards. Those standards require that we plan and perform the audit to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objectives. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives.

Background

DOD operates the MHS to support medical readiness by ensuring the health and fitness of service members and to support morale by providing medical care to service members, retirees, and their families. In the MHS, health care services are often provided at military training facilities. A wide range of clinical services is available at these facilities, depending on their size, mission, and levels of capability.

To support the delivery of health care services, DOD has, over time, developed, procured, and maintained a variety of legacy electronic health record systems. Each system has different functions and capabilities; for example, the department operates separate inpatient, outpatient, and

dental systems. The department also operates several other individual systems that are used for managing referrals, tracking medical readiness, and sharing data with VA, among other things.

Since 1998, DOD and VA have worked to exchange electronic health records. Further, in 2008, Congress mandated that the two departments achieve interoperability between their electronic health record systems.⁷ DOD determined that its systems needed to be modernized and replaced. In order to modernize its systems and achieve interoperability with VA, DOD is acquiring a commercial product.

In July 2015, DOD awarded a \$4.3 billion contract to the Leidos Partnership for Defense Health to implement MHS GENESIS, based on commercially available products. In 2018, DOD modified the contract to support incorporating the United States Coast Guard into MHS GENESIS, among other activities, at an additional cost of \$1.2 billion. The system is intended to integrate inpatient and outpatient medical and dental information, support the availability of medical records for all DOD beneficiaries worldwide, enable increased standardization, and integrate health care delivery.

DOD revised its schedule for completing the deployment of MHS GENESIS in February 2021. This schedule calls for implementing MHS GENESIS in 24 waves (i.e., phases). The first wave was completed in October 2017 and the last wave is expected to deploy by December 2023 with additional activities planned through 2025. In February 2022, DOD estimated that its deployment of MHS GENESIS was 38 percent completed.

In September 2021, we reported on the progress that DOD had made in implementing MHS GENESIS and the challenges that remain, including those associated with incidents identified during testing, training and communication, and frequent system changes.⁸ We recommended that DOD develop an approach to retest incidents, improve training, and

⁷Interoperability allows patients' electronic health information to move with them from provider to provider, regardless of where the information originated. If electronic health records conform to interoperability standards, they can be created, managed, and consulted by authorized clinicians and staff across more than one health care organization, thus providing patients and their caregivers the necessary information required for optimal care.

⁸GAO, *Electronic Health Records: DOD Has Made Progress in Implementing a New System, but Challenges Persist*, [GAO-21-571](#) (Washington, D.C.: Sept. 20, 2021).

develop a plan to ensure MHS GENESIS users are aware of system changes. DOD concurred with and described plans to address the recommendations.

Cost Estimating

A high-quality, reliable cost estimate is a key tool for budgeting, planning, and managing federal programs. According to the Office of Management and Budget (OMB), programs must maintain current and well-documented estimates of program costs, and these estimates must encompass the full life cycle of the program.⁹ Among other things, OMB policy states that generating reliable program cost estimates is a critical function necessary to support the capital programming process. Without this capability, agencies are at risk of experiencing program cost overruns, missed deadlines, and performance shortfalls.

A cost estimate provides a structured accounting of all labor, material, and other efforts required to develop, produce, operate and maintain, and dispose of a program. The development of a cost estimate entails identifying and estimating all cost elements that pertain to the program from initial concept all the way through each phase in the program's duration. The program cost estimate encompasses all past (or sunk), present, and future costs for every aspect of the program, regardless of funding source.

Our research has shown that in order to conduct oversight of the federal government, including agencies' stewardship of public funds, reliable cost information is required. GAO's Cost Estimating and Assessment Guide (referred to as the cost guide throughout) outlines best practices for developing reliable cost estimates that management can use to make informed decisions.¹⁰ These practices are organized into four characteristics—comprehensive, well-documented, accurate, and credible. Table 1 summarizes the four characteristics and corresponding best practices of a reliable cost estimate identified in the cost guide.

⁹Office of Management and Budget, *Preparation, Submission, and Execution of the Budget*, Circular No. A-11 (Washington, D.C.: June 2006); *Management of Federal Information Resources*, Circular No. A-130 Revised (Washington, D.C.: Executive Office of the President, Nov. 28, 2000); and *Capital Programming Guide: Preparation, Submission, and Execution of the Budget*, Supplement to Circular A-11, Part 7 (Washington, D.C.: June 2006).

¹⁰[GAO-20-195G](#).

Table 1: Four Characteristics and Best Practices of a Reliable Cost Estimate, According to GAO’s Cost Estimating and Assessment Guide

Characteristic	Corresponding best practices
Comprehensive	<ul style="list-style-type: none"> • The cost estimate includes all life cycle costs. • The technical baseline description completely defines the program, reflects the current schedule, and is technically reasonable. • The cost estimate is based on a work breakdown structure that is product-oriented, traceable to the statement of work, and at an appropriate level of detail to ensure that cost elements are neither omitted nor double-counted. • The cost estimate documents all cost-influencing ground rules and assumptions.
Well-documented	<ul style="list-style-type: none"> • The documentation should show the source data used, the reliability of the data, and the estimating methodology used to derive each element’s cost. • The documentation describes how the estimate was developed so that a cost analyst unfamiliar with the program could understand what was done and replicate it. • The documentation discusses the technical baseline description and the data in the technical baseline are consistent with the cost estimate. • The documentation provides evidence that the cost estimate is reviewed and accepted by management.
Accurate	<ul style="list-style-type: none"> • The cost estimate is regularly updated to ensure it reflects program changes and actual costs. • The cost model was developed by estimating each work breakdown structure element using the best methodology from the data collected. • The estimate has been adjusted properly for inflation. • The cost estimate contains few, if any, minor mistakes. • Variances between planned and actual costs are documented, explained, and reviewed. • The estimate is based on a historical record of cost estimating and actual experiences from other comparable programs.
Credible	<ul style="list-style-type: none"> • The cost estimate included a sensitivity analysis that identifies a range of possible costs based on varying major assumptions, parameters, and data inputs. • A risk and uncertainty analysis was conducted that quantified the imperfectly understood risks and identified the effects of changing key cost driver assumptions and factors. • Major cost elements were cross-checked to see if results were similar. • An independent cost estimate was conducted by a group outside the acquiring organization to determine whether other estimating methods produce similar results.

Source: GAO analysis of [GAO-20-195G](#). | GAO-22-104521

The cost guide provides a framework for assessing the extent of an estimate’s adherence to each characteristic based on the following scale:

- Met: Evidence satisfies the entire criterion.
- Substantially Met: Evidence satisfies a large portion of the criterion.
- Partially Met: Evidence satisfies about half of the criterion.
- Minimally Met: Evidence satisfies a small portion of the criterion.
- Not Met: Evidence satisfies none of the criterion.

GAO considers a reliable cost estimate as one that either met or substantially met each characteristic.

According to GAO's cost guide, reliable cost estimates are critical for successfully delivering IT programs. Such estimates provide the basis for informed decision-making, realistic budget formulation, meaningful progress measurement, and accountability for results. Management minimizes the risk of cost overruns and unmet performance targets by ensuring cost estimates reflect those characteristics by meeting best practices.

Program Scheduling

The success of a project depends, in part, on having an integrated and reliable master schedule that defines when and how long work will occur, and how each activity is related to the others. Integrated master schedules are a consolidation of lower level project (i.e. subproject) schedules. A well-planned schedule is a fundamental management tool that can help government programs use public funds effectively by specifying when work will be performed in the future and measuring program performance against an approved plan. Moreover, as a model of time, an integrated and reliable schedule can show when major events are expected as well as the completion dates for all activities leading up to them, which can help determine if the program's parameters are realistic and achievable.

We have previously reported in our Schedule Assessment Guide (referred to as the schedule guide throughout) that a reliable schedule can provide a road map for the systematic execution of a program and the means by which to gauge progress, identify and address potential problems, and promote accountability.¹¹ A schedule provides a time sequence for the duration of a program's activities and helps everyone understand both the dates for major milestones and the activities that drive the schedule.

Moreover, it is an essential basis for managing tradeoffs between cost, schedule, and scope. Among other things, scheduling allows program management to decide between possible sequences of activities and determine the flexibility of the schedule according to available resources. Further, it can predict the consequences of managerial action or inaction

¹¹[GAO-16-89G](#)

on events, and allocate contingency plans to mitigate risks. Our research has identified 10 best practices associated with effective schedule estimating. These 10 best practices are grouped into four characteristics for sound schedule estimating: comprehensive, well-constructed, credible and controlled. Table 2 summarizes the four characteristics and corresponding best practices of a reliable schedule identified in the schedule guide.¹²

Table 2: Four Characteristics and Best Practices of a Reliable Schedule, According to GAO’s Schedule Assessment Guide

Characteristic	Corresponding best practices
Comprehensive	<ul style="list-style-type: none"> • Capture all activities, as identified in the work breakdown structure, which defines in detail the work for both the government and its contractors necessary to accomplish a program’s objectives. • Establishes the duration of all activities in the same time unit (preferably days) and has specific start and end dates. • Reflects what resources (e.g., labor, materials, and overhead) are needed to do the work, whether all required resources will be available when needed, and whether any funding or time constraints exist.
Well-constructed	<ul style="list-style-type: none"> • Sequences all activities—that is, all activities are sequenced in the order that they are to be implemented with the most straightforward logic possible. • Establishes a valid critical path, which represents the chain of dependent activities with the longest total duration. A valid critical path is necessary to examine the effects of any activity slippage along this path. • Identifies the total float time—the amount of time by which an activity can slip before the delay affects the program’s estimated finish date—so that a schedule’s flexibility can be determined.
Credible	<ul style="list-style-type: none"> • Verifies that the schedule is (1) horizontally traceable, meaning that it reflects the order of events necessary to achieve aggregated products or outcomes; and (2) vertically traceable, meaning that activities in varying levels of the schedule align with one another and key dates presented to management in periodic briefings are consistent with the schedule. • Conducts a schedule risk analysis to predict a level of confidence in meeting the program’s completion date and the level of necessary schedule contingency.
Controlled	<ul style="list-style-type: none"> • Updates schedule regularly using actual progress and logic to realistically forecast dates for program activities. • Maintains a baseline schedule to measure, monitor, and report the program’s progress.

Source: GAO analysis of [GAO-16-89G](#). | GAO-22-104521

The schedule guide provides a framework for assessing the extent of an estimate’s adherence to each characteristic based on the following scale:

- Met: Evidence satisfies the entire criterion.
- Substantially Met: Evidence satisfies a large portion of the criterion.
- Partially Met: Evidence satisfies about half of the criterion.

¹²[GAO-16-89G](#).

- Minimally Met: Evidence satisfies a small portion of the criterion.
- Not Met: Evidence satisfies none of the criterion.

GAO considers a reliable schedule as one that either met or substantially met each characteristic.

Cost Estimate and Subproject Schedules Were Not Fully Consistent with Best Practices

The MHS GENESIS cost estimate and subproject schedules collectively satisfied four of the eight characteristics, including the underlying best practices, associated with reliability. However, because neither the cost estimate nor the subproject schedules met or substantially met all of the characteristics, they are unreliable.

MHS GENESIS’s Cost Estimate Substantially Met Two of Four Characteristics for Reliability

DOD’s October 2020 MHS GENESIS’s cost estimate was unreliable because it did not substantially meet all four characteristics of a reliable cost estimate described in our cost guide. Specifically, although the cost estimate substantially met the comprehensive and accurate characteristics, it partially met the well-documented characteristic and minimally met the credible characteristic. Table 3 summarizes the results of our assessment of the characteristics and the best practices of MHS GENESIS’s October 2020 cost estimate.

Table 3: Assessment of the Department of Defense’s (DOD) Military Health System (MHS) GENESIS’s October 2020 Cost Estimate Compared to Cost Estimating Best Practices

Characteristic and corresponding best practices	Assessment	Summary of assessment
Comprehensive <ul style="list-style-type: none">• The cost estimate includes all life cycle costs.• The technical baseline description completely defines the program, reflects the current schedule, and is technically reasonable.	●	<ul style="list-style-type: none">• The cost estimate included all known and anticipated federal government and contractor costs from inception through full deployment plus ten years of sustainment. DOD officials reported that key out-of-scope elements were identified, as well as key critical dependencies that were outside of the program scope.

Characteristic and corresponding best practices	Assessment	Summary of assessment
<ul style="list-style-type: none"> The cost estimate is based on a work breakdown structure (WBS) that is product-oriented, traceable to the statement of work, and at an appropriate level of detail to ensure that cost elements are neither omitted nor double-counted. The cost estimate documents all cost-influencing ground rules and assumptions. 		<ul style="list-style-type: none"> DOD officials reported that the baseline is documented with sufficient detail to develop a robust cost estimate, as are its key changes over time. Specifically, the MHS GENESIS program office provided reports that indicate the cost estimate is based on a programmatic and technical baseline in the cost analysis requirements description (CARD). Officials reported that the CARD was developed and is updated in coordination with program management office staff and is reviewed for approval by the program manager. However, we found that the CARD was last updated in 2016, so we cannot confirm that the technical baseline description has been maintained and updated in preparation for program reviews, milestone decisions, and major program changes. A WBS dictionary exists and is product-oriented and traceable because it defines what is included in each element and how it relates to others in the deliverable-oriented hierarchy. The cost estimate WBS matches the schedule WBS, as well as the earned value management WBS. In addition, the WBS contains an appropriate level of detail, outlining the end-product and major work of the program with hardware and software elements, program management and other common elements. The cost estimate does not define and document the risks associated with the ground rules and assumptions and the rationale and historical data to support them. In addition, the ground rules and assumptions were not used for any sensitivity and uncertainty analyses.
<p>Well-documented</p> <ul style="list-style-type: none"> The documentation should show the source data used, the reliability of the data, and the estimating methodology used to derive each element's cost. The documentation describes how the estimate was developed so that a cost analyst unfamiliar with the program could understand what was done and replicate it. The documentation discusses the technical baseline description and the data in the technical baseline are consistent with the cost estimate. The documentation provides evidence that the cost estimate is reviewed and accepted by management. 	●	<ul style="list-style-type: none"> The electronic cost model listed methods used to identify costs. However, the cost estimate documentation does not list details regarding assumptions, methodology, and areas of uncertainty and risk that drove the development of the point estimate by the WBS element for the cost estimate.^a Further, there is no evidence of an assessment of the accuracy of the data and reliability and circumstances affecting the data in the cost estimate documentation submitted. Finally, the electronic cost model does not describe how the data were normalized. The documentation does not fully describe how the estimate was developed so that a cost analyst unfamiliar with the program could understand what was done and replicate it. Specifically, the documentation does not contain a narrative with an executive summary, introduction, and descriptions of methods, with data broken out by WBS cost elements, sensitivity analysis, risk and uncertainty analysis, and updates that reflect actual costs and changes for the cost estimate. The documentation discusses the technical baseline description. However, the CARD was last updated in 2016 and therefore is outdated for purposes of our review because it would not contain current information regarding the current technical and program risks consistent with the cost estimate. While DOD officials stated that costs are regularly reviewed by management, they did not provide evidence that management reviewed and accepted the cost estimate.

Characteristic and corresponding best practices	Assessment	Summary of assessment
<p>Accurate</p> <ul style="list-style-type: none"> • The cost estimate is regularly updated to ensure it reflects program changes and actual costs. • The cost model was developed by estimating each WBS element using the best methodology from the data collected. • The estimate has been adjusted properly for inflation. • The cost estimate contains few, if any, minor mistakes. • Variances between planned and actual costs are documented, explained, and reviewed. • The estimate is based on a historical record of cost estimating and actual experiences from other comparable programs. 	●	<ul style="list-style-type: none"> • The electronic cost model and supporting documentation reflect program changes and actual costs. However, the cost estimate did not document the changes in technical or programmatic assumptions and how these changes affected it. • DOD officials provided evidence that several methods were used. However, they did not provide evidence in the cost model that the estimating method was always used appropriately. It was also not clear if overhead and fee were added to the cost estimate when the build-up estimating methodology was used. • Officials reported that the cost data was adjusted for inflation so that it could be described in like terms and to ensure that comparisons and projections were valid. • The cost estimate contained few, if any, minor mistakes. However, officials did not provide evidence that the program used a quality control process to ensure the cost estimates contained few, if any mistakes. • The cost estimate supporting documentation contained variances and indicated that the cost estimate was refined using lessons learned. However, the variances and lessons learned within the cost estimate supporting documentation did not provide evidence of whether actual costs or schedules differed from the estimate and there was no evidence that sunk costs were compared to the original estimates for the cost estimate. • The cost estimate was based on historical records. However, the historical data did not completely describe the data sources used to determine if the data could be used to estimate accurate costs for the new program. In addition, officials did not provide evidence that steps had been taken to determine that the data were applicable to the program and that data were reliable for the cost estimate.
<p>Credible</p> <ul style="list-style-type: none"> • The cost estimate included a sensitivity analysis that identifies a range of possible costs based on varying major assumptions, parameters, and data inputs. • A risk and uncertainty analysis was conducted that quantified the imperfectly understood risks and identified the effects of changing key cost driver assumptions and factors. • Major cost elements were cross-checked to see if results were similar. • An independent cost estimate (ICE) was conducted by a group outside the acquiring organization to determine whether other estimating methods produce similar results. 	○	<ul style="list-style-type: none"> • DOD did not provide evidence that a sensitivity analysis was performed for the cost estimate.^b • DOD did not provide evidence that a risk and uncertainty analysis was performed for the cost estimate. In addition, the time-phased risks in the risk tab of the electronic cost model were not allocated to WBS elements and it was not clear if and how the risk model accounted for correlation between risks, between cost elements, and how risk was distributed among cost elements when more than one was affected by a given risk. • Neither the electronic cost model nor supporting documentation contained evidence that different cost estimation methods produced similar results across major cost elements. • Program officials stated that an ICE was performed in 2015 and that they plan to conduct internal peer-reviewed assessments for a future update to the cost estimate. However, DOD officials stated that an ICE was not performed for the current cost estimate.

Legend:

-
- = Met: The program office provided complete evidence that satisfies the entire criterion.
 - = Substantially Met: The program office provided evidence that satisfies a large portion of the criterion.
 - ◐ = Partially Met: The program office provided evidence that satisfies about half the criterion.
 - ◑ = Minimally Met: The program office provided evidence that satisfies a small portion of the criterion.
 - = Not Met: The program office provided no evidence that satisfied any of the criterion.

Source: GAO analysis of Department of Defense data and [GAO-20-195G](#). | GAO-22-104521

^aA point estimate is the anticipated program costs without risk and uncertainty added.

^bSensitivity analysis first identifies key elements that drive cost and their associated assumptions and then calculates the estimate's sensitivity to changes in the underlying assumptions.

MHS GENESIS program officials provided information in response to our assessments of the well-documented and credible characteristics as partially met and minimally met, respectively. Specifically, the officials provided documentation of prior year cost estimates that they asserted included such items as ground rules and assumptions, methodology, a risk and uncertainty analysis, updates that reflect actual cost and changes, and programmatic and technical baseline descriptions. However, the information they referenced was from a previous estimate prepared in 2016 and is outdated for the purposes of our review.

With respect to the credible characteristic, program officials also described actions they intend to address specific practices. For example, the officials stated that while they did not conduct an additional detailed sensitivity analysis, they do plan to conduct a formal sensitivity analysis as part of a future update to the cost estimate. Further, while a formal ICE was not conducted, the Program Executive Office for the Defense Healthcare Management System reviewed the cost estimate and planned to conduct internal peer-reviewed assessments as part of a subsequent update to the cost estimate.

Without a cost estimate that includes complete documentation on how DOD developed the estimate or evidence that the department conducted an ICE, sensitivity, and risk and uncertainty analysis, questions about the approach and data used to create the estimate may not be answered and the scope of the estimate may not be defined, among other concerns. By implementing a cost estimate that does not meet all four characteristics and associated best practices, DOD is making budget decisions based on potentially inaccurate data. As such, the program risks being unable to effectively estimate future funding needs and using unreliable data to make budgetary decisions.

MHS GENESIS’s Subproject Schedules Substantially Met Two of Four Characteristics for Reliability

Although three of the subprojects in DOD’s MHS GENESIS February 2021 schedule collectively substantially met the comprehensive and controlled characteristics, the subprojects collectively partially met the well-constructed and credible characteristics of a reliable schedule. As a result, the MHS GENESIS schedule was unreliable. Table 4 summarizes our assessment of the characteristics and the best practices of the three subprojects in DOD’s MHS GENESIS February 2021 schedule.

Table 4: Assessment of the Extent to Which Selected Subproject Schedules for Military Health System GENESIS Collectively Met Best Practices

Schedule characteristic	Assessment	Summary of assessment
<p>Comprehensive</p> <ul style="list-style-type: none"> Captures all activities, as identified in the work breakdown structure (WBS), which defines in detail the work for both the government and its contractors necessary to accomplish a program’s objectives. Establishes the duration of all activities in the same time unit (preferably days) and has specific start and end dates. Reflects what resources (e.g., labor, materials, and overhead) are needed to do the work, whether all required resources will be available when needed, and whether any funding or time constraints exist. 	●	<ul style="list-style-type: none"> The integrated master schedule (IMS) and subproject schedules contained activities for both the government and its contractors necessary to accomplish a program’s objectives through 2025, although it was unclear whether the IMS captured the entire duration of effort needed. The subproject schedules’ activities included a contractor WBS element and a contractor WBS dictionary for tracking key deliverables. In addition, activity and milestones names were descriptive, however, there were minor instances of non-unique names. The subproject schedules we evaluated included the resources needed to do the work, by name and labor category, and depicted when those resources were needed. However, we found instances of over allocated resources, which led us to question whether all assignments were realistic. Officials did not provide evidence of efforts made to resolve resource over allocation. Over allocated resources result in inefficiency (for example, staff are less productive because of extended overtime) or program delay from unavailable resources. The Military Health System GENESIS program office had a process in place to ensure that realistic activity duration estimates allow for discrete progress measurement. Activity durations in the subprojects we assessed were short enough to be consistent with the needs of effective planning and program execution.
<p>Well-constructed</p> <ul style="list-style-type: none"> Sequences all activities—that is, all activities are sequenced in the order that they are to be implemented with the most straightforward logic possible. 	●	<ul style="list-style-type: none"> There were no instances of dangling or start-to-finish logic, and no summary links in the project schedules that we examined, and the subprojects include a relatively small number of missing logic and unjustified and inactive date constraints. The subprojects contained a relatively small number of date constraints, although the subproject 2 schedule had 43 start no earlier constraints—that is, constraints that prevent activities from starting earlier than a specified date. We also identified 16 activities in the subproject 2 schedule with lags, some as long as 40 days.^a

Schedule characteristic	Assessment	Summary of assessment
<ul style="list-style-type: none"> Establishes a valid critical path, which represents the chain of dependent activities with the longest total duration. A valid critical path is necessary to examine the effects of any activity slippage along this path. Identifies the total float time—the amount of time by which an activity can slip before the delay affects the program’s estimated finish date—so that a schedule’s flexibility can be determined. 		<ul style="list-style-type: none"> The subproject schedules varied in the quality of their critical paths. The subproject 3 schedule path was straightforward, and the critical activities demonstrated that they were driving the key milestones within the schedule. However, for subproject 1, while the path was continuous and free of constraints, we were unable to reconcile the activities marked as critical in the subproject’s schedule with those on the driving path to the key completion milestone. That is, activities in the subproject 1 schedule marked as critical may not have been those that were truly driving the key milestone. In addition, we were unable to validate the subproject 2 critical path because its key completion milestone was being driven by 63 predecessors. In this case, it is unclear how management identified the sequence of activities that determine its finish date. Its critical path, as marked by the software, may have been hampered by date constraints. In addition, we were unable to fully trace the subproject 2 critical activities to those shown in the performance report’s critical path. Finally, we were unable to fully trace the critical paths in the IMS to the custom critical path reported to stakeholders. While subproject 1 substantially met the criteria for reasonable total float, subprojects 2 and 3 schedules exhibited positive total float values that probably did not represent the actual degree of flexibility in the schedule. For example, 38.4 percent of subproject 2 schedule activities have total float greater than 2 working months, and subproject 3 schedule has a maximum total float value of 1,122 days—that is, it appears that key activities and milestones could slip months or years before delaying key program activities.
<p>Credible</p> <ul style="list-style-type: none"> Verifies that the schedule is (1) horizontally traceable, meaning that it reflects the order of events necessary to achieve aggregated products or outcomes; and (2) vertically traceable, meaning that activities in varying levels of the schedule align with one another and key dates presented to management in periodic briefings are consistent with the schedule. Conducts a schedule risk analysis (SRA) to predict a level of confidence in meeting the program’s completion date and the level of necessary schedule contingency. 	①	<ul style="list-style-type: none"> The IMS contained instances of valid vertical traceability. However, the IMS is not fully horizontally traceable because delays to some activities did not appear to impact all finish dates of key milestones. That is, delays to some activities push the end date of some finish milestones, but not others. Program officials provided the summary results of SRAs that they conducted. However, there was no evidence of supporting detailed SRA assumptions or methodology documentation included.

Schedule characteristic	Assessment	Summary of assessment
Controlled	●	<ul style="list-style-type: none"> Program officials reported that their schedule narrative information was input into a performance report by officials trained and experienced in critical path method scheduling and reported monthly to the Department of Defense. In addition, there were only a small number of date anomalies in the IMS and that at least one critical activity was in progress in the subprojects that we reviewed. However, there was no evidence of a discussion on changes in network logic, including lags, date constraints, and relationship logic and their effect on the schedule time. Program officials reported that both the Department of Defense and the contractor utilized baseline schedules as the basis for measuring performance. The subproject schedules had a baseline assigned. In addition, the February 2021 performance report listed baseline schedule variances for key milestones. However, we did not find a schedule basis document that detailed ground rules and assumptions used in developing the schedule, and justified constraints, lags, long activity durations, and any other unique features of the schedule.

Legend:

- = Met: The program office provided complete evidence that satisfies the entire criterion.
- = Substantially Met: The program office provided evidence that satisfies a large portion of the criterion.
- ◐ = Partially Met: The program office provided evidence that satisfies about half the criterion.
- ◑ = Minimally Met: The program office provided evidence that satisfies a small portion of the criterion.
- = Not Met: The program office provided no evidence that satisfied any of the criterion.

Source: GAO analysis of Department of Defense data and [GAO-16-89G](#). | GAO-22-104521

^aA lag in a schedule denotes the passage of time between two activities. Lags simply delay a successor activity—no effort or resources are associated with this passage of time.

MHS GENESIS program officials provided information in response to our assessments of the well-constructed and credible characteristics as partially met. With respect to the critical path, officials stated that while some of the tasks in subprojects 1 and 2 have zero float and thus are on the critical path, others are “near critical path” tasks that have 7 or fewer days of float and therefore are not critical path tasks in the strict sense. However, they stated that the tasks are deemed critical due to the fact that minor delays could negatively impact the critical path by pushing the completion date out. Unless the schedule can produce a true critical path, the program office will not be able to provide reliable timeline estimates or identify when problems or changes may occur and their effects on downstream work. Program officials did not provide an explanation for our findings related to total float.

With respect to the credible characteristic, MHS GENESIS program officials did not agree with GAO’s applicability of horizontal traceability for their program. Specifically, officials responded that horizontal traceability is coordinated among the team. However, we determined that the

schedule did not demonstrate that delays to some activities affect key milestone dates. With respect to SRA, program officials disagreed with the extent to which the analysis should be documented. Specifically, the officials stated that the analyses prepared for program reviews included discussions that explored priorities, identified risks to project completion, and provided documentation of schedule risks. However, the documentation did not include key elements such as how schedule contingency was developed.

Because the subproject schedules we assessed did not meet all four characteristics of a high quality, reliable estimate, DOD's MHS GENESIS schedule is also unreliable. As a result, the department faces an increased risk of experiencing uncertain completion dates, time extension requests, delays, and increased project costs. In addition, employing an unreliable schedule decreases management's ability to make informed decisions related to possible sequences of activities and the flexibility of the schedule according to available resources, among other things.

Conclusions

The MHS GENESIS cost estimate and schedules for selected subprojects substantially met half of the characteristics and best practices associated with reliable cost and schedule estimates. However, the MHS GENESIS cost and schedule estimates were not reliable because they did not fully or substantially meet all characteristics associated with reliable estimates. Without reliable cost and schedule estimates, DOD increases the risk that management will not have the information necessary for effective decision-making. Further, following cost and schedule estimating best practices helps minimize the risk of cost overruns and schedule delays and would better position MHS GENESIS for success which is important since the majority of deployments have yet to occur.

Recommendations for Executive Action

We are making the following two recommendations to DOD:

The Secretary of Defense should direct the Program Executive Officer of Defense Health Management Systems to ensure that the program office develops a reliable cost estimate using best practices described in GAO's Cost Estimating and Assessment Guide, in particular, by addressing

those cost practices that were partially or minimally met.
(Recommendation 1)

The Secretary of Defense should direct the Program Executive Officer of Defense Health Management Systems to ensure that the program office develops a reliable schedule using best practices described in GAO's Schedule Assessment Guide, in particular, by addressing those schedule practices that were partially met. (Recommendation 2)

Agency Comments

We provided a draft of this report to DOD for review and comment. In its comments, reproduced in appendix II, the department concurred with our recommendations. DOD also provided technical comments, which we incorporated as appropriate.

We are sending copies of this report to the appropriate congressional committees and the Secretary of Defense. In addition, the report is available at no charge on the GAO website at <http://www.gao.gov>.

If you or your staff have any questions on the matters discussed in this report, please contact me at (202) 512-4456 or at harriscc@gao.gov. Contact points for our Offices of Congressional Relations and Public Affairs may be found on the last page of this report. GAO staff who made major contributions to this report are listed in appendix III.



Carol C. Harris
Director, Information Technology Management Issues

Appendix I: Objectives, Scope and Methodology

The objective of this report was to determine to what extent Department of Defense's (DOD) Military Health System (MHS) GENESIS's cost estimate and program schedule are consistent with cost estimating and schedule assessment best practices.

To address the objective, we evaluated documentation supporting the program's October 2020 cost estimate against the characteristics and associated best practices for developing an estimate that is comprehensive, accurate, well-documented, and credible, as identified in GAO's Cost Estimating and Assessment Guide.¹

To determine the reliability of the cost estimate data, we reviewed how the cost for each work breakdown structure (WBS) element was calculated with an emphasis on the basis for the estimates and the strength and quality of the supporting documentation. We verified that the parameters used to create the estimate were valid and applicable by comparing them to available cost estimating references. We verified that calculations were correct for each WBS element and that escalation was properly applied and that WBS elements were summed accurately to arrive at the overall program cost estimate. We determined that the data used were sufficiently reliable for the purpose of evaluating DOD's adoption of cost estimating best practices.

Additionally, we reviewed the MHS GENESIS integrated master schedule (IMS), dated February 2021, and related supporting documentation against the characteristics and associated best practices for developing a schedule that is comprehensive, well-constructed, credible, and controlled, as identified in GAO's Schedule Assessment Guide.²

As the IMS is detailed and highly complex due to the large number of integrated subprojects and activities, we conducted assessments of three subprojects contained within the IMS for analysis. Because an IMS

¹GAO, *Cost Estimating and Assessment Guide: Best Practices for Developing and Managing Program Costs*, [GAO-20-195G](#) (Washington, D.C.: March 2020).

²GAO, *Schedule Assessment Guide: Best Practices for Project Schedules*, [GAO-16-89G](#) (Washington, D.C.: December 2015).

consolidates subproject schedules, errors and reliability issues in subproject schedules will be reflected in higher-level schedules. The subprojects we assessed were selected based on whether they were on-going and whether they included a significant and varying number of discrete activities in the project schedule.

The three subprojects represent approximately 20 percent of the remaining activities in the IMS. The subprojects are Apple Product Improvement Engineering (subproject 1), Stage 6 (subproject 2), and Elderberry Product Improvement Engineering (subproject 3).

Assessing three subprojects limits possible statements about the program's entire schedule. For example, if the program is not following best practices in creating and maintaining the three subproject schedules, we can conclude that the larger integrated schedule is unreliable. However, if the selected subprojects are deemed reliable, we cannot definitively determine the reliability of the integrated master schedule because the other subprojects that were not assessed may be unreliable.

To determine the reliability of the schedule estimate data, we employed GAO defined schedule filters to identify missing logic or constraints. We copied the resulting schedule data from each of the filters used into a spreadsheet to check for specific problems that could hinder the schedule's ability to dynamically respond to changes. Specifically, we searched for activities with missing dependencies and constraints, and identified any lags or leads. We determined if activities were resource loaded and examined whether resources were over allocated or not available when needed. We examined the length of activity durations and compared them to the program management review cycle and checked for horizontal and vertical integration within the schedule. Further, we examined the schedule's critical path, schedule float and whether the schedule was baselined. We determined that the data used were sufficiently reliable for the purpose of evaluating DOD's adoption of schedule estimating best practices.

For both the cost estimate and subproject schedules, we assessed each characteristic relative to the following scale:

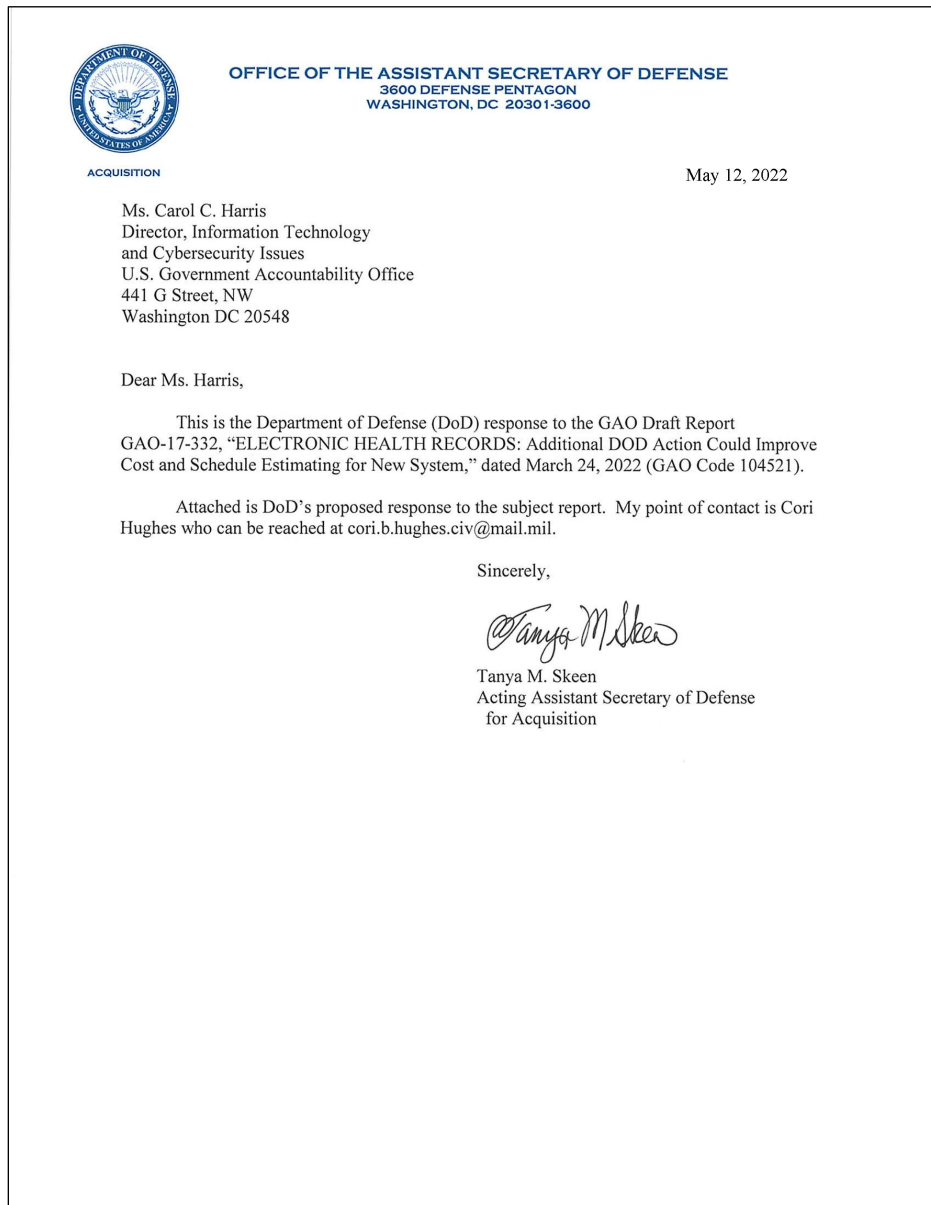
- Met. DOD provided complete evidence that satisfies the entire criterion.
- Substantially met. DOD provided evidence that satisfies a large portion of the criterion.

- Partially met. DOD provided evidence that satisfies about one-half of the criterion.
- Minimally met. DOD provided evidence that satisfies a small portion of the criterion.
- Not met. DOD provided no evidence that satisfies any of the criterion.

In addition, we interviewed DOD officials in the MHS GENESIS program office to understand their practices for developing and maintaining the cost estimate and program schedule. Further, we provided DOD with draft versions of our detailed analyses of the MHS GENESIS cost estimate and schedule and asked the officials to verify the information on which we based our findings. When warranted, we updated our analyses based on the department's response and additional documentation provided to us.

We conducted this performance audit from September 2020 to June 2022 in accordance with generally accepted government auditing standards. Those standards require that we plan and perform the audit to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objectives. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives.

Appendix II: Comments from the Department of Defense



**GOVERNMENT ACCOUNTING OFFICE DRAFT REPORT DATED MARCH 24, 2022
GAO-22-104521 (GAO CODE 104521)**

**ELECTRONIC HEALTH RECORDS: Additional DOD Actions Could Improve Cost and
Schedule Estimating for New System**

**DEPARTMENT OF DEFENSE COMMENTS
TO THE GAO RECOMMENDATION**

RECOMMENDATION 1: The Secretary of Defense should direct the Program Executive Officer of Defense Health Management Systems (PEO DHMS) to ensure that the program office develops a reliable cost estimate using best practices described in Government Accounting Office (GAO)'s *Cost Estimating and Assessment Guide*, in particular, by addressing those cost practices that were partially or minimally met.

DoD RESPONSE: Department of Defense (DoD) concurs with the recommendation that PEO DHMS ensure the program office develop a reliable cost estimate using best practices described in GAO's Cost Estimating and Assessment Guide.

RECOMMENDATION 2: The Secretary of Defense should direct the PEO of DHMS to ensure that the program office develops a reliable schedule using best practices described in GAO's *Schedule Assessment Guide*, in particular, by addressing those schedule practices that were partially met.

DoD RESPONSE: DoD concurs with the recommendation that PEO DHMS ensure the program office develops a reliable schedule using best practices described in GAO's Schedule Assessment Guide.

Text of Appendix II: Comments from the Department of Defense

Ms. Carol C. Harris

Director, Information Technology and Cybersecurity Issues

U.S. Government Accountability Office 441 G Street, NW

Washington DC 20548

Dear Ms. Harris,

May 12, 2022

This is the Department of Defense (DoD) response to the GAO Draft Report

GAO-17-332, "ELECTRONIC HEALTH RECORDS: Additional DOD Action Could Improve Cost and Schedule Estimating for New System," dated March 24, 2022 (GAO Code 104521).

Attached is DoD's proposed response to the subject report. My point of contact is Cori Hughes who can be reached at cori.b.hughes.civ@mail.mil.

Sincerely,

Tanya M. Skeen

Acting Assistant Secretary of Defense for Acquisition

GOVERNMENT ACCOUNTING OFFICE DRAFT REPORT
DATED MARCH 24, 2022 GAO-22-104521 (GAO CODE 104521)
ELECTRONIC HEALTH RECORDS: Additional DOD Actions
Could Improve Cost and Schedule Estimating for New System

DEPARTMENT OF DEFENSE COMMENTS TO THE GAO
RECOMMENDATION

RECOMMENDATION 1: The Secretary of Defense should direct the Program Executive Officer of Defense Health Management Systems (PEO OHMS) to

ensure that the program office develops a reliable cost estimate using best practices described in Government Accounting Office (GAO)'s Cost Estimating and Assessment Guide, in particular, by addressing those cost practices that were partially or minimally met.

DoD RESPONSE: Department of Defense (DoD) concurs with the recommendation that PEO OHMS ensure the program office develop a reliable cost estimate using best practices described in GAO's Cost Estimating and Assessment Guide.

RECOMMENDATION 2: The Secretary of Defense should direct the PEO of OHMS to ensure that the program office develops a reliable schedule using best practices described in GAO's Schedule Assessment Guide, in particular, by addressing those schedule practices that were partially met.

DoD RESPONSE: DoD concurs with the recommendation that PEO OHMS ensure the program office develops a reliable schedule using best practices described in GAO's Schedule Assessment Guide.

Appendix III: GAO Contact and Staff Acknowledgments

GAO Contact

Carol Harris, (202) 512-4456 or harriscc@gao.gov

Staff Acknowledgments

In addition to the contact named above, Mark Bird (Assistant Director), Season Burris (Analyst in Charge), Juaná Collymore, Donna Epler, and Umesh Thakkar made key contributions to this report.

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