Improving Patient Outcomes and Lowering Hospital Readmissions with AWS

October 2019

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Abstract

This whitepaper uses the research results provided in the comparative study Successful hospital readmission reduction initiatives: Top five strategies to consider implementing today to present mechanisms that can help healthcare organizations engage with patients more successfully and reduce hospital readmissions. A reference architecture and sample call flows are provided to illustrate the implementation of each of the five strategies presented in the study.

Introduction

What can a healthcare organization do to lower readmissions? How can it improve outcomes for the patient and the organization? How can it implement mechanisms to cost effectively lower readmissions while maintaining patient-centered care? The comparative study Successful hospital readmission reduction initiatives: Top five strategies to consider implementing today provides research information from across multiple organizations and publications which shows specific strategies that a healthcare organization can implement for meaningful results. Specifically, the study identifies the five strategies to take along with a key conclusion, as provided in the following excerpt.

> "This study reports that collaboration, home visits, telephone follow-up, education, and discharge planning are the most frequently studied and the most successful strategies to reduce unplanned readmissions across varying statistical measures. While enhanced by organizational and system-level performance, the success of each initiative is primarily patient driven."

This paper explores how we can use AWS services to create mechanisms to implement each of the strategies identified in the study for a generic healthcare organization in a way that engages patients successfully. We'll offer data security recommendations to keep patient and customer data secure and safe using a variety of AWS services. In addition, we'll list the AWS services available to help you meet your compliance efforts.

Create Voice-centric Mechanisms Using AWS Services

The study reports that voice or phone conversation is key when engaging patients. The solution presented in this paper supports voice communication robustly and is built using AWS services to trigger mechanisms for each of the strategies covered in the study including:

- Home visits
- Education
- Discharge planning

- Collaboration
- Telephone follow-up

For each strategy, a common trigger that can be used are HL7 (Health Level 7) messages. HL7 messages are used by virtually every healthcare organization. In addition, for many of the strategies, the electronic medical record system is already generating the specific messages required. Only an additional end point needs to be specified to provide an automated trigger.

> **Note:** There has been much innovation around using other communication mechanisms such as email and SMS. However, the comparative study—Successful hospital readmission reduction initiatives—identified voice (that is, phone calls) as the only communication mechanism that is effective. This is not to say that other communication channels could not, in theory, be effective, but none of the research that was reviewed in this study showed a particularly effective implementation.

Use Amazon Connect to Deliver Voice Communication

To help deliver voice communication, we'll build our solution leveraging Amazon Connect. Amazon Connect is a self-service, cloud-based contact center service that makes it easy for any business to deliver better customer service at lower cost. Amazon Connect is based on the same contact center technology used by Amazon customer service associates around the world to power millions of customer conversations. The self-service graphical interface in Amazon Connect makes it easy for non-technical users to design contact flows, manage agents, and track performance metrics. Specialized skills are not required. There are no up-front payments or long-term commitments and no infrastructure to manage. Pay by the minute for Amazon Connect usage plus any associated telephony services.

Using Amazon Connect, you can set up call flows such as '*Press 1 if you would like a home healthcare nurse to visit you'* which routes the patient to a home healthcare nurse for scheduling. Call flow flexibility includes integrating multi-language and natural human language support (which lets you manually input your prompts instead of creating an audio recording). Additionally, automate outgoing calls using an API or command line interface (CLI) call. Time and labor savings for a nurse's time related to patient follow-ups can be made by having a system that can verify that the patient wants to talk to a

healthcare provider. Automation helps a healthcare provider be able to focus live support to actual patient care.

Reference Architecture and Mechanisms Set-up

How do you set up HL7 messages to trigger calls in AWS? There are many options to set up this function, but one common implementation option is to use the Apache Camel utility, which has the ability to act as an HL7 listener and put an object into Amazon Simple Storage Service (Amazon S3). Refer to Figure 1 to review the reference architecture that brings all the pieces together.

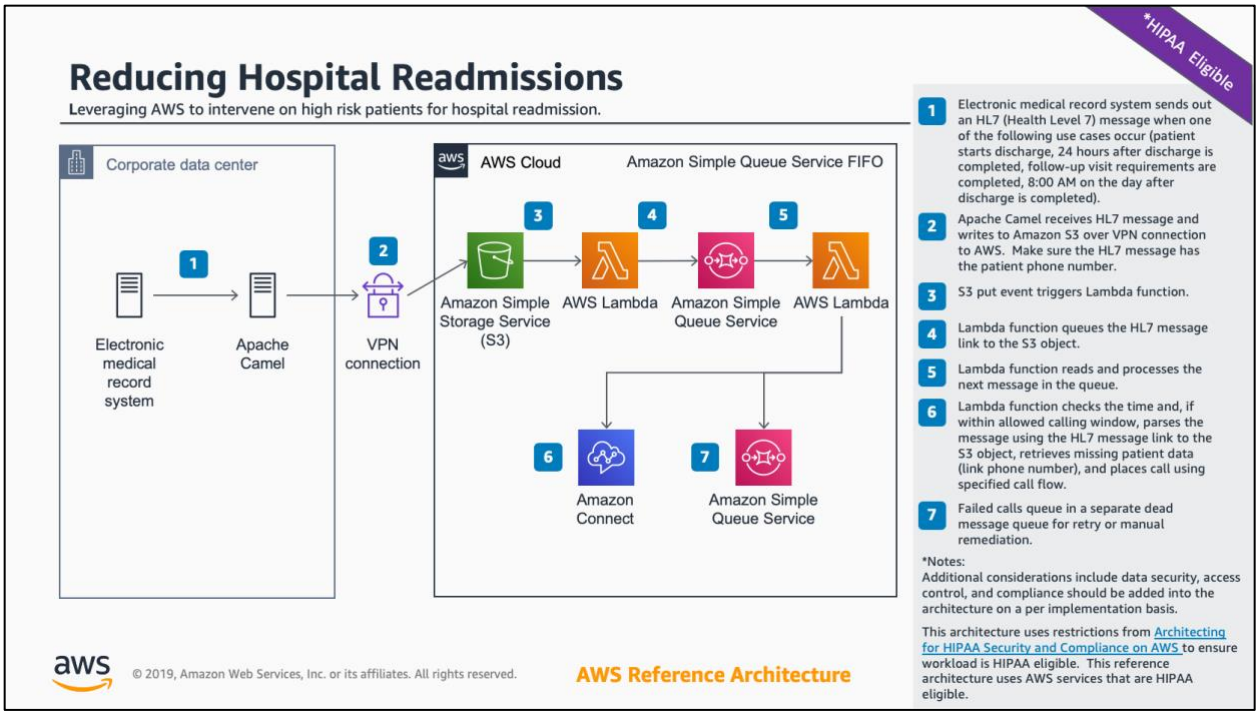

Figure 1: Reducing hospital readmissions reference architecture

> **Note:** The reference architecture Reducing Hospital Readmissions applies to each of the strategies covered in this paper. What is unique is the call flow set-up for each case.

When creating the call flow for each strategy, first determine an HL7 trigger message to start the workload. For the discharge planning call flow, healthcare organizations, may already have an existing discharge start and discharge complete message that can be

copied to the Camel listener. Prior to set up, determine whether you need to configure new messages or use an alternative approach like setting a time delay from existing messages. The goal is to use voice communication to reach patients and route them to the correct clinician. Next, we'll walkthrough the setup for each strategy.

Home Visits

Home visits are a straightforward and effective way to prevent hospital readmissions. The goal for this strategy is to determine whether a patient or caregiver desires a visit, and, if so, to schedule the visit. Figure 2 shows the call flow where the entry point is to obtain the customer's input. The patient (or point-of-contact) is called and queried whether a home visit is desired. If the response is positive, the contact is connected to a call queue where an appointment can be set up with a clinician.

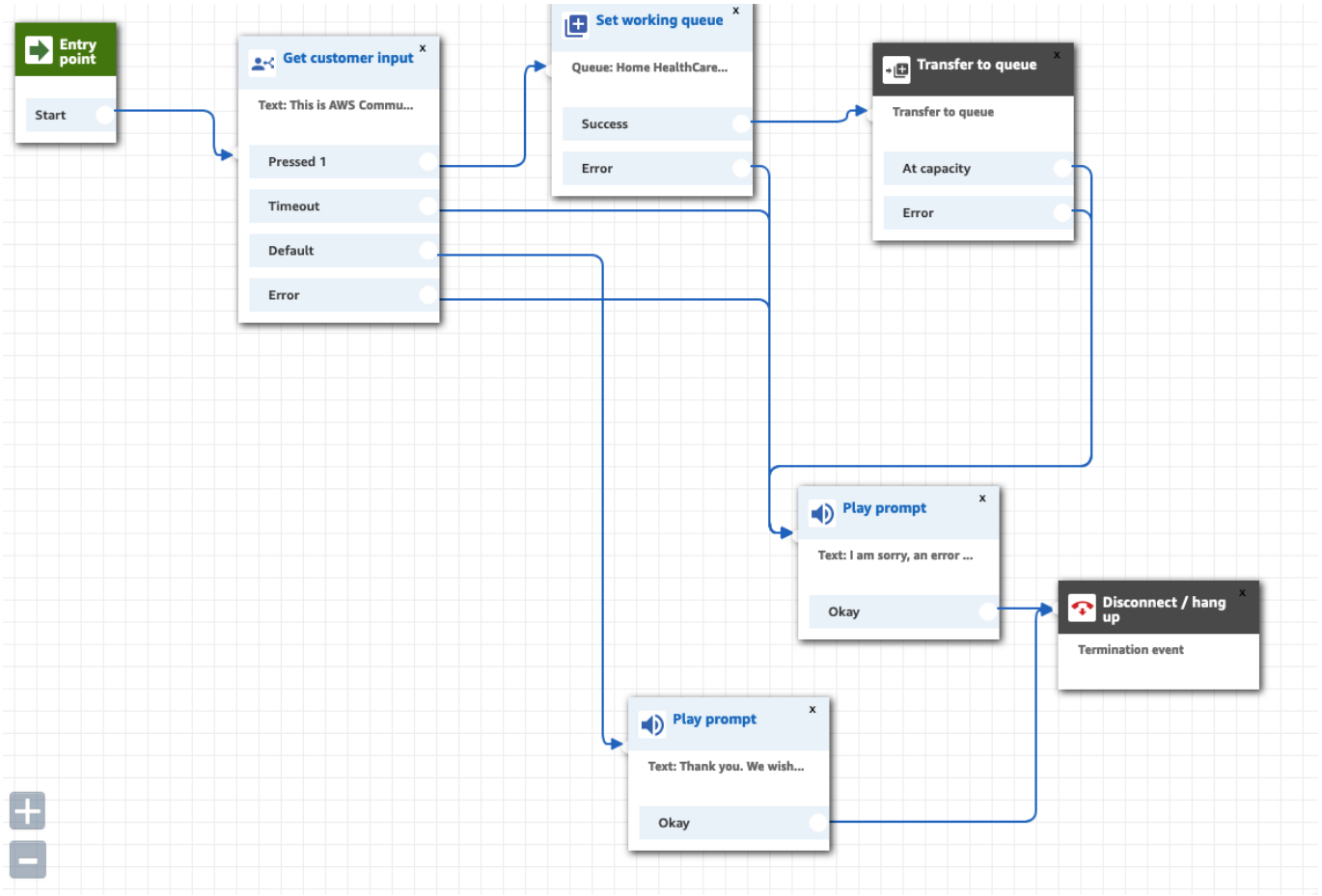

Figure 2: Home visit call flow

Education

Education regarding post hospitalization care and wellness does not have to be complex, but does need to be internalized by the patient and caregiver to be effective. Many programs suffer from two key failures: (1) not ensuring the patient understands the instructions before leaving the hospital and (2) not following up after discharge to verify that instruction has been retained and is being followed. Figure 3 shows the generic call flow with the key questions that should be asked:

- Do you understand how to take care of yourself after your recent hospital stay?
- Do you have any questions about problems or symptoms you are experiencing?
- Do you need any help taking care of yourself?

In this call flow, the patient is routed to a nurse for consultation and education if the answer to any of the questions indicates a need for assistance.

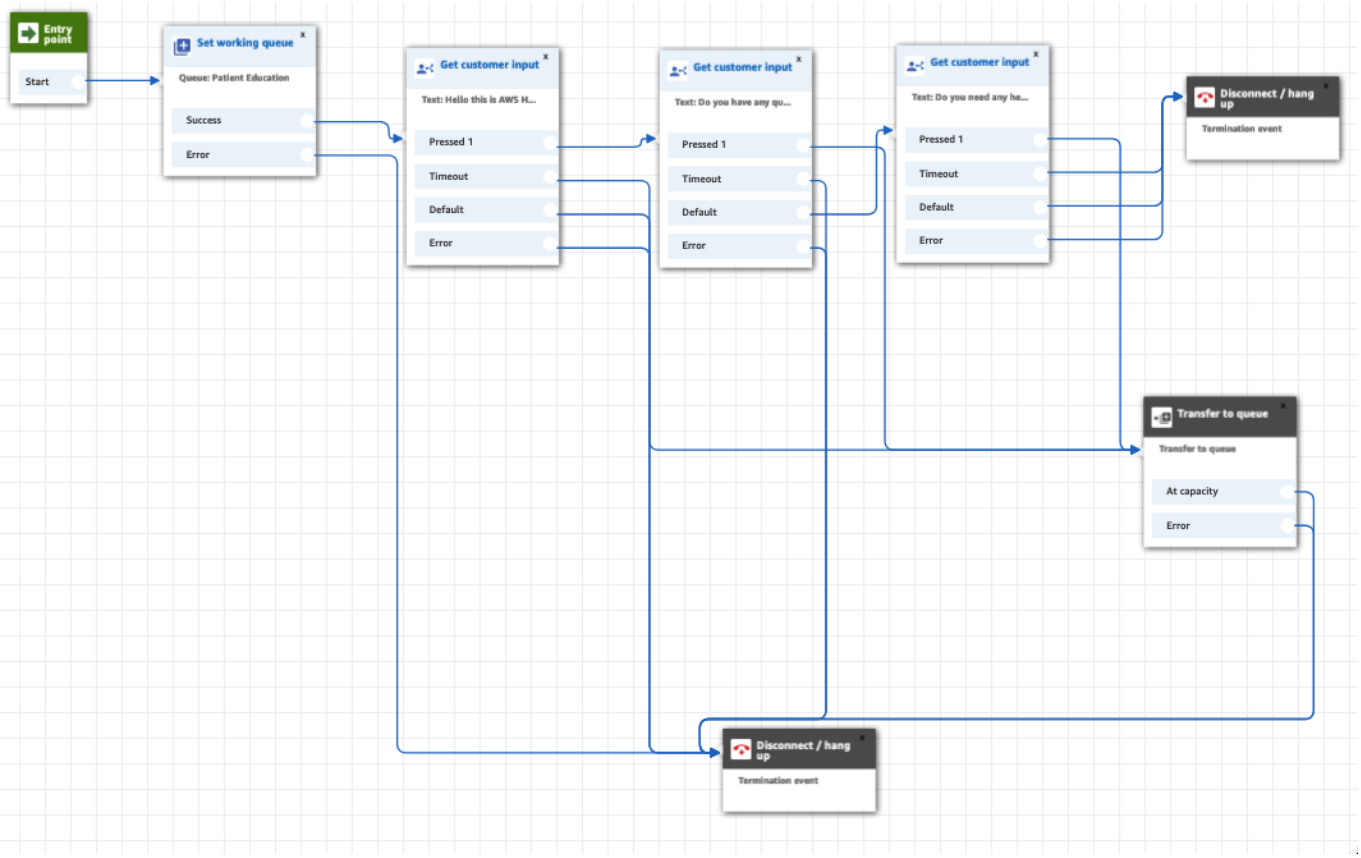

Figure 3: Education call flow

Discharge Planning

Discharging patients from a hospital can be complex, especially if a patient has several co-morbidities to address. A patient discharged without completing the essential steps of the discharge process is at increased risk for readmission. Figure 4 shows the call flow for a patient or caregiver being contacted during the discharge process to verify all critical steps have been completed successfully. This example assumes the patient or caregiver has a cell phone, but in cases where a cell phone is unavailable, a hospital or care facility's room phone may be substituted, if available. Sample questions for this call flow include:

- Do you have your medication prescriptions?
- Do you have your discharge instructions?
- Do you have questions about your discharge instructions?
- Do you know what follow up appointments you require?
- Do you have your follow up appointments scheduled?
- Do you have a safe place to go when you leave the hospital?
- Do you have transportation from the hospital?

These questions, taken from the comparative study Successful hospital readmission reduction initiatives, when used in a call flow, provided discharge process improvements as related to hospital readmissions.

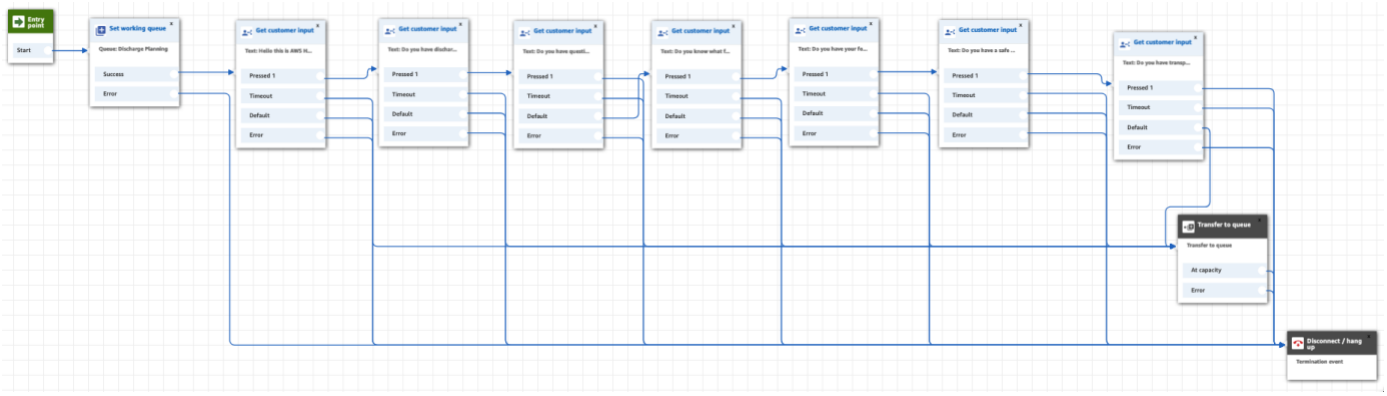

Figure 4: Discharge planning call flow

Collaboration

The call flow for collaboration is not well defined in the comparative study. For this solution, we'll use the following questions for the call flow:

- Have you scheduled your follow-up appointments?
- Did you miss any follow-up appointments?
- Do you have transportation to the appointment?

Failing to get proper care after discharge, often by not getting recommended follow-ups, is a common contributor to hospital readmission. Figure 5 shows the contact flow for the sample collaboration questions.

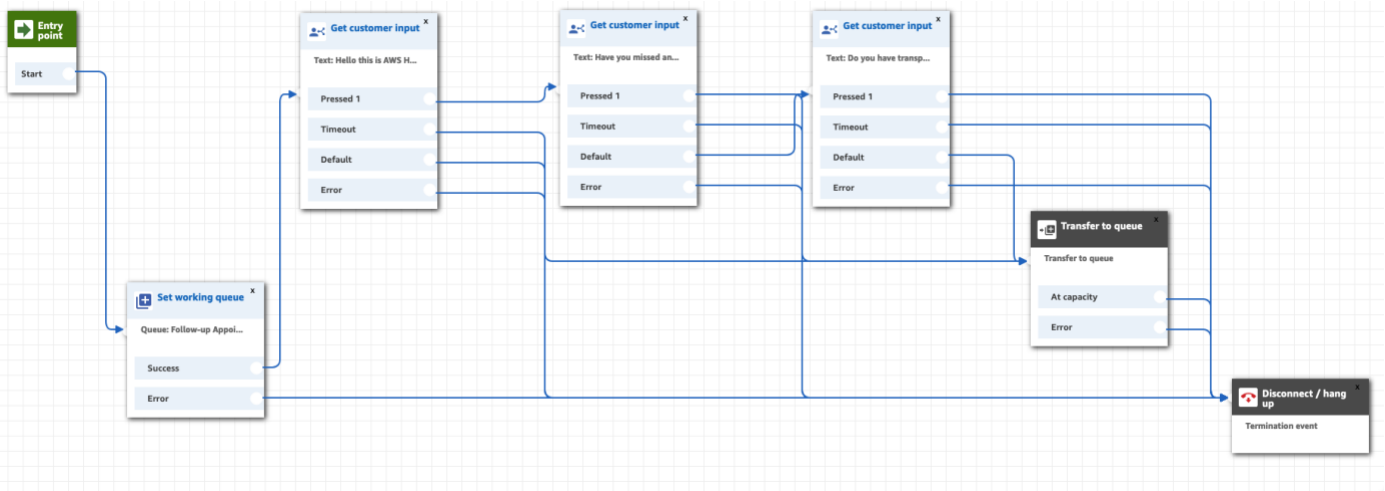

Figure 5: Collaboration call flow

Telephone Follow-up

Telephone follow-up is straightforward with Amazon Connect. Figure 6 shows the system calling the patient, asking whether they are well, and determining whether they need medical assistance.

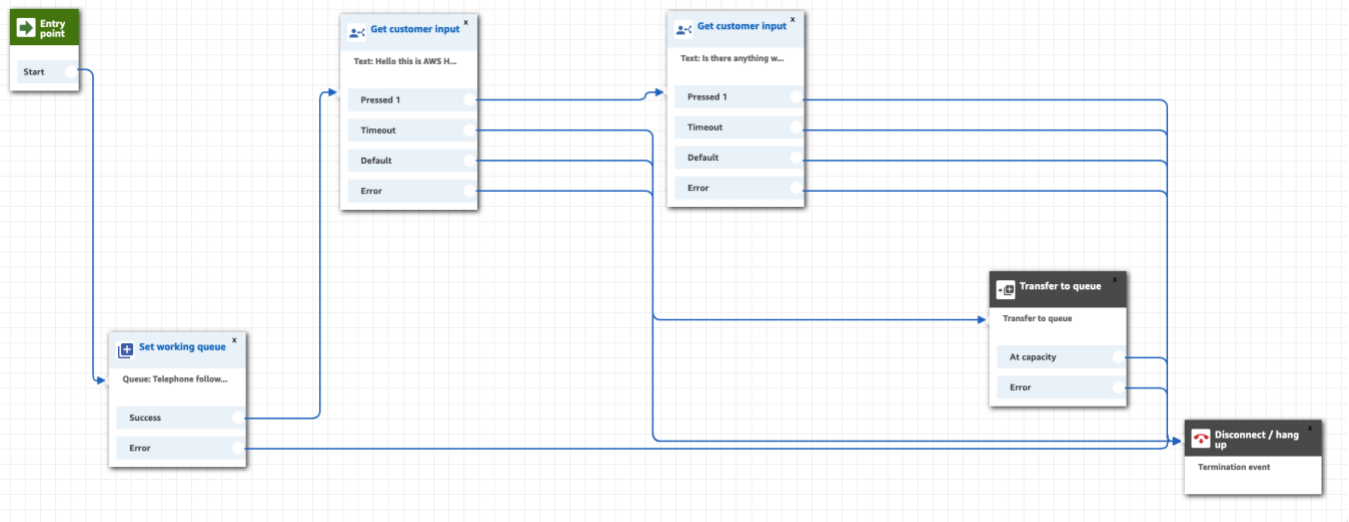

Figure 6: Telephone follow-up call flow

Security and Compliance

If you choose to implement any of the solutions presented in this paper, consider your deployment strategy as well as the data security implications. AWS offers a comprehensive suite of security tools to help you establish a secure AWS environment in your voice call flows. For example, you can integrate AWS Identity and Access Management (IAM), AWS Security Token Service (AWS STS), AWS CloudTrail, and AWS IoT Device Management for the following purposes:

- IAM enables you to maintain segregation of access, fine-grained access control, and secure end-user mobile and web applications
- AWS STS provides a secure, self-expiring, time-boxed, temporary security credentials to third-party administrators and service providers, which helps to strengthen your security posture
- CloudTrail logs IAM and STS API calls
- AWS IoT Device Management securely onboards, organizes, monitors, and remotely manages IoT devices at scale

With AWS, you can add an additional layer of security to your data at rest in the cloud. Beyond the reference architecture presented in this paper, AWS provides scalable and efficient encryption features for services like Amazon EBS, Amazon S3, Amazon Redshift, Amazon SNS, AWS Glue, and many more. Flexible key management options, including AWS Key Management Service, enable you to choose whether to have AWS

manage the encryption keys or to keep complete control over their keys. In addition, AWS provides APIs for you to integrate encryption and data protection with any of the services that you develop or deploy in an AWS environment.

To assist you with your compliance efforts, AWS continues to add services to the various compliance regulations, attestations, certifications, and programs across the world. To decide which services are suitable for you, refer to AWS Services in Scope.

You can use various AWS services such as AWS CloudTrail, AWS Config, Amazon GuardDuty, and AWS Key Management Service (AWS KMS) to enhance your compliance and auditing efforts. Refer to the AWS Compliance Solutions Guide.

As a medical practitioner, it is critical that you evaluate the security of a cloud solution and be able to distinguish between the security of the cloud and security in the cloud. The AWS Shared Responsibility Model details this relationship.

> **Note:** Refer to the AWS Cloud Security site to learn more about the advantage of the AWS cloud, the AWS Well-Architected Framework (specifically the Security pillar), and security resources at your disposal.

Data Privacy

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Conclusion

We have presented potential call flows for improving hospital readmissions. More importantly, they can be used to improve patient outcomes, engagement, and satisfaction. These improvements can have impacts beyond just hospital readmissions. Impacts could include increased revenue and reimbursement (especially in population health scenarios), as well as improvements in your healthcare organization's rankings. The call flows are inexpensive, quick to implement, and have the potential to deliver significant benefits. We encourage you try them and share your experiences with AWS.

Contributors

Contributors to this document include:

- Brian Niemeyer, Solutions Architect, Amazon Web Services

Further Reading

For additional information, see:

- Journal of Hospital Administration. Vol 7, No 6 (2018). Successful hospital readmission reduction initiatives: Top five strategies to consider implementing today.

Document Revisions

Date	Description
October 2019	First publication