

Red Hat validated pattern for healthcare

Highlights:

- ▶ Accelerate diagnoses by automating pipelines and using AI inferencing at the edge.
- ▶ Focus practitioner time on cases that are difficult to diagnose.
- ▶ Increase case throughput with event-driven architecture pipelines based on Red Hat OpenShift.
- ▶ Continually refine, retrain, and improve ML models based on expert human input.

Accelerate and improve X-ray diagnoses at the medical edge

Faced with unprecedented challenges including staffing issues, burnout, increasing supply chain issues and limited space—all exacerbated by the global pandemic—medical practitioners need systems that help them diagnose cases more accurately and in less time. Reducing the time needed to diagnose and respond to acute symptoms can make the difference between life and death for some patients. At the same time, automated systems can help overtaxed practitioners reduce the time they spend on performing routine diagnosis.

The combination of edge computing and artificial intelligence and machine learning (AI/ML) benefits healthcare providers by bringing processing power closer to data. While doctors continue to have the final say on diagnosis, automated anomaly detection can increase diagnostic efficiency. Event-driven architectures can help automate medical diagnoses, as demonstrated by this [Red Hat edge validated pattern](#) that assists X-ray diagnosis.

This validated pattern uses an established workflow running on [Red Hat® OpenShift®](#) to detect case probability for pneumonia diagnosis and continual improvement. Based on an automated data pipeline, the solution automatically expands and contracts container-based resources based on the influx of data and uses inferencing to categorize new X-rays into a high, low, or unknown probability of pneumonia. Cases with a high probability are escalated to the medical staff for immediate evaluation. Images can be automatically anonymized to protect patient information, and then fed back to the data science team to help retrain and improve the model. In addition to accelerating response time for the most critical patients and increasing case throughput, medical experts can focus their time on cases that are the most difficult to interpret.

Practical reusable patterns with Red Hat edge validated patterns

While data engineers have access to powerful modern tools, they are often called upon to compose complex end-to-end data pipeline solutions from multiple products. Contributions to collateral, blueprints, code repositories and workshops have made distributed architectures more repeatable and scalable, yet sample code and demos only address some of the challenges. Organizations must still adapt parts of the pattern, build custom workflows, and then test and manage the pattern life cycle.

Red Hat validated patterns simplify and accelerate this process by delivering a repeatable, tested approach while maintaining the life cycle of the deployment. Validated patterns are based on best practices developed through working with organizations who run patterns in their environments. Red Hat then operationalizes these distributed architectures by using continuous integration/continuous delivery (CI/CD) tools such as Red Hat OpenShift Pipelines (Tekton) and Red Hat OpenShift GitOps (ArgoCD). Workflows are codified, so that various modules within the solution are built, deployed, and maintained together.

Through a layered approach, the validated patterns framework is able to separate areas of concern for better focus. Edge cluster management, GitOps, DevOps, and product operations are all kept within their respective layers. This approach makes it easier to deploy new components if needed, such as adding additional sites, applications, and cloud native Kubernetes operators. Existing components can also be easily replaced as product updates occur.

Red Hat validated patterns also help partners more intuitively integrate their products into other-wise complex pipelines. Since patterns are reproducible, they can be scaled as required—within a core datacenter or public cloud or out to multiple edge locations. Patterns can be repeated for other organizations, modified for differentiation, and extended for different workloads and use cases.

Assisted X-ray diagnosis with Red Hat OpenShift

The [medical edge validated pattern](#) effectively combines multiple technologies into an automated workflow (Figure 1). It is purpose-built for pneumonia diagnosis, and offers:

- ▶ Faster diagnosis.
- ▶ Focused practitioner time.
- ▶ Increased case throughput.

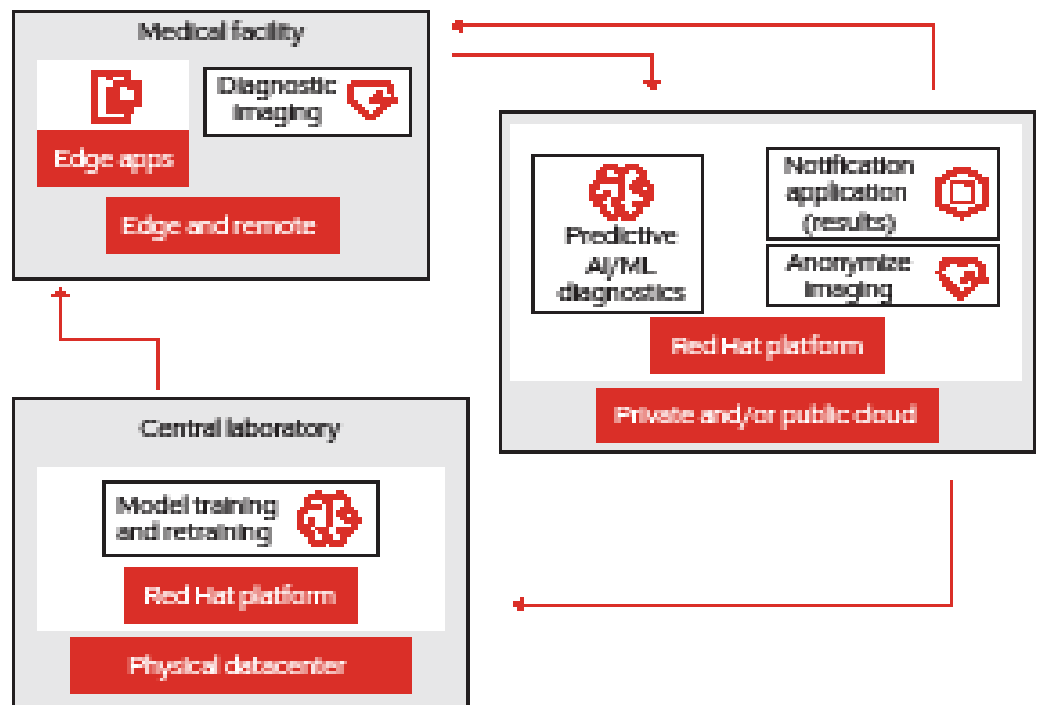


Figure 1. The X-ray diagnosis validated pattern accelerates diagnoses with continual improvement through expert input.

The system is designed to rapidly notify medical staff of high-confidence diagnosis while continually retraining and improving the system with anonymized images.

1. At the edge, X-rays are stored as Amazon Web Services (AWS) Simple Storage Service (S3) objects.
2. Ceph® bucket notifications in [Red Hat OpenShift Data Foundation](#) automatically generate Apache Kafka topics with [Red Hat AMQ](#) that are then consumed by Knative eventing using [Red Hat OpenShift serverless](#).
3. Serverless containers are generated on-demand, with predefined Jupyter notebooks, Python scripts, and Tensorflow performing image analysis to classify X-rays as a high or low risk of pneumonia (0-100% probability).
4. Images with a high-confidence diagnosis (greater than 80%) are reported to appropriate medical staff for confirmation and treatment.
5. Images with lower confidence are automatically anonymized and sent to the central datacenter for further image analysis and continual retraining to improve the model for increased accuracy.
6. Trend analysis reports on ML risk-prediction accuracy over time.

About Red Hat

Red Hat is the world's leading provider of enterprise open source software solutions, using a community-powered approach to deliver reliable and high-performing Linux, hybrid cloud, container, and Kubernetes technologies. Red Hat helps customers develop cloud-native applications, integrate existing and new IT applications, and automate and manage complex environments. [A trusted adviser to the Fortune 500](#), Red Hat provides [award-winning](#) support, training, and consulting services that bring the benefits of open innovation to any industry. Red Hat is a connective hub in a global network of enterprises, partners, and communities, helping organizations grow, transform, and prepare for the digital future.

The validated pattern is customizable, and it can be modified by practitioners to extend to other diagnostic use cases and operate with Health Level Seven (HL7) Fast Healthcare Interoperability Resources (FHIR) protocols, to integrate within the clinical setting.

Conclusion

Operationalized workflows through event-driven architectures can greatly accelerate a project from proof of concept to a production-ready deployment. Red Hat has worked extensively with organizations developing proofs of concept and functional deployments of distributed architectures from the network edge and extending to hybrid and multicloud environments. By codifying and continuously integrating and delivering validated patterns for key industry and horizontal use cases, organizations, partners, and consultants are able to quickly deploy, extend, and scale solutions.

Red Hat invites you to participate. Download this medical diagnosis pattern or other patterns in our [validated patterns repository](#). In addition, our [community patterns](#) are available for individuals to fork, contribute, and use. As organizations continue developing their application modernization strategy, these tools will help accelerate workload modeling and uncover new use cases that bring edge computing and AI into the mainstream.



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