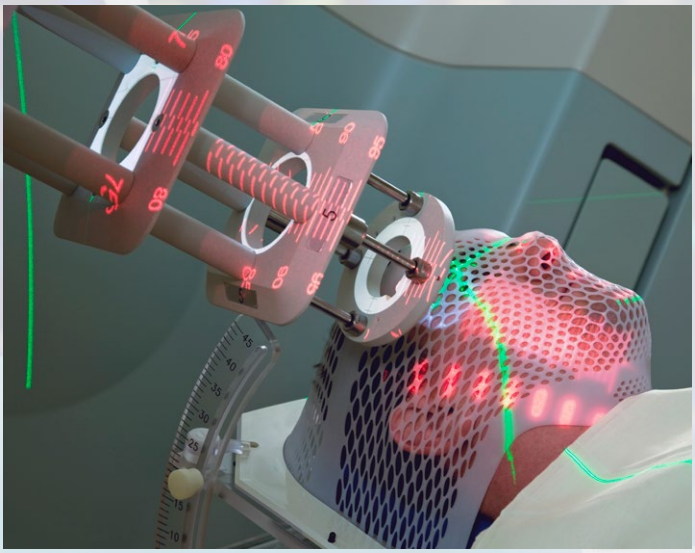

PUTTING PATIENTS FIRST WITH CLOUD-DRIVEN PHARMACEUTICAL INNOVATION

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Senior leaders from **ZS** and **Amazon Web Services (AWS)** join us to discuss end-to-end transformation in the pharmaceutical industry to prioritise patient outcomes from discovery to deployment and beyond.

LIFE SCIENCES ORGANISATIONS MUST LEVERAGE DATA-DRIVEN INSIGHTS TO MAKE INFORMED DECISIONS THAT DRIVE INNOVATION, OPTIMISE OPERATIONS AND IMPROVE PATIENT OUTCOMES ACROSS THE HEALTHCARE CONTINUUM.

However, unlocking the full potential of data analytics while maintaining regulatory compliance and data privacy is a significant challenge.

Through a powerful collaboration, ZS, a leading consulting and technology firm, and Amazon Web Services (AWS), the world's most comprehensive and broadly adopted cloud, are pioneering transformative cloud-based solutions to help modernisation along the entire life science value chain and reimagine care delivery.

In this exclusive interview, industry leaders from ZS and AWS discuss the cutting-edge innovations developed using AWS to transform drug discovery, clinical trials, commercial operations, manufacturing and supply chains as well as patient services.

Today, we are joined by Kapil Pant, Global Head of Enterprise Data Management & Analytics, Asheesh Shukla, Managing Principal at ZS, Dennis Lauth, Head of Life Sciences Commercial Strategy & Solutions, and Chris McCurdy, Chief Architect for Healthcare and Life Sciences at AWS.

The executives explore how AWS' secure, scalable and cost-efficient cloud infrastructure powers ZS's advanced data and analytics capabilities. They delve into use cases demonstrating how these cloud-native solutions enable pharmaceutical companies to extract powerful insights, enhance decision-making, increase operational agility and deliver improved health outcomes.

CO-INNOVATING FOR IMPROVED PATIENT OUTCOMES

ZS's work with AWS is founded on a shared passion for leveraging cloud technologies and data-driven insights to help transform patient care across the healthcare ecosystem.

"AWS is one of our key collaborators," states Kapil Pant, Global Head of Enterprise Data Management & Analytics at ZS Associates. "Our complementary expertise allows us to co-develop differentiated solutions that unlock value for clients spanning the pharmaceutical value chain and broader healthcare domains."

Asheesh Shukla, Managing Principal at ZS, highlights two central pillars of the collaboration. "First, we are connecting fragmented patient experiences by integrating structured and unstructured multimodal data while upholding stringent compliance and privacy standards. Second, we

are empowering last-mile care by translating data-driven insights into enhanced patient services and optimised care journeys with agility and responsiveness."

"ZS and AWS both prioritise customer-centricity," Asheesh adds. "This innate focus on those we serve – patients, providers and the healthcare industry – is tremendously beneficial as we innovate together."

Dennis Lauth, Head of Life Sciences Commercial Strategy & Solutions at AWS, explains the complementary value proposition. "Our collaboration combines ZS's deep domain proficiency with AWS' transformative technologies and enables a shared vision of an integrated, frictionless healthcare system powered by interoperable data," says Dennis. "For over 17 years, Amazon Web Services (AWS) has delivered innovative cloud solutions to millions of customers globally across diverse use cases. More than a decade ago, AWS launched a dedicated healthcare and life sciences practice focused on unlocking the power of health data and transforming the life science value chain enabled by cloud technologies."

Chris McCurdy, Chief Architect for Healthcare and Life Sciences at AWS adds, "We have developed an array of purpose-built, HIPAA-eligible solutions like AWS HealthLake, AWS HealthOmics and Amazon Comprehend Medical to help customers unleash the value of health data. At AWS, we believe technology can make healthcare better, faster, more equitable and sustainable."

Complementing AWS' transformative cloud technologies is ZS, a pioneering life sciences consultancy adept at solving intricate challenges across the R&D and commercialisation lifecycle. ZS combines deep domain proficiency with industry-leading solutions architected on the AWS cloud.

Dennis cites the growing demand for personalised healthcare experiences that improve outcomes, enhance patient journeys and reduce costs as a key motivator for innovating together.

"Nearly every customer I've spoken to within the last two years seeks to put the patient at the centre through connected, integrated care," explains Dennis. "However, patients currently face a fragmented, siloed experience. We must transform care delivery by empowering patients and providers through technology-enabled solutions that leverage multi-modal data to decode complex patient journeys. AWS and ZS share a belief that cloud innovations can reimagine care experiences and the entire pharmaceutical value chain."

END-TO-END INNOVATION

ZS aims to work with AWS to transform patient outcomes and use technology to remove frictions in the healthcare system. But how do they approach this ambitious goal? The answer lies in end-to-end innovation, from discovery to deployment and beyond.

"R&D is a vast space, and at ZS, we see the research and development aspects as distinct, each with its own unique characteristics and requirements," says Asheesh. "However, at the very start of the process, we bring the patient into the core of our R&D endeavours, which implies three critical factors.

"The first factor is productivity. We must consider how to leverage existing patient data to inform both the R&D and clinical sides of care," says Asheesh. "The second factor is

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Kapil Pant, Global Head of Enterprise Data Management & Analytics at ZS

precision, ensuring highly accurate information to support the discovery of new molecules, the development of targeted product profiles, and the addressing of unmet market needs. The third and most crucial factor is the patient experience, putting the patient first at every stage of the journey."

Elaborating on ZS's work with AWS to promote productivity, precision, and patient experience, Asheesh describes how the two companies collaborate and harness data-driven insights and technology to serve patients better. Using patient experience and precision within the R&D process as examples, Asheesh highlights critical challenges in the journey, including awareness, engagement and representation – areas where ZS and AWS are working to drive meaningful change.

"When a patient participates in clinical development, three major challenges are how they find a relevant trial, how they engage in the process, and how healthcare stakeholders engage with patients," says Asheesh. "This is a significant focus area, where we prioritise enhancing the patient experience through a multitude of technologies. This includes providing cloud-based digital solutions that can be built and deployed at scale to facilitate and streamline the two-way communication between researchers and trial participants. This not only alleviates friction points and lowers barriers to patient's involvement in trials, it also promotes transparency, reduces the risk of missed appointments or data gaps, and fosters trust between all stakeholders."

Turning to the precision element of the patient-driven approach to R&D, Asheesh emphasises the need to target ideal patients for improving outcomes.

"Technology helps to mine through a plethora of structured and

"AI-POWERED SOLUTIONS CAN HELP TO INTELLIGENTLY MATCH PATIENTS AGAINST THE COMPLEX INCLUSION AND EXCLUSION CRITERIA OF CLINICAL TRIALS"

Asheesh Shukla, Managing Principal at ZS

unstructured multimodal-multiomics data to identify patients who might benefit most from these therapies," says Asheesh. "AI-powered solutions can help to intelligently match patients against the complex inclusion and exclusion criteria of clinical trials. These criteria often involve intricate combinations of factors, such as age, medical history, comorbidities, genetic markers, and laboratory values, making manual assessment challenging and prone to errors. By augmenting this process, AI can rapidly evaluate large patient populations, accurately identifying those who meet the eligibility requirements, to find suitable candidates and optimal trial locations for more effective recruitment, ultimately accelerating trial timelines, and bringing life-saving therapies to patients faster.

"Moreover, ZS is exploring ways to bring trials directly to patients leveraging AWS, ensuring awareness and facilitating participation, especially in areas like oncology, where patients are highly motivated to contribute to the development process to support the advancement of new medicines.

"When it comes to precision, we should not only monitor patients participating in clinical development or trials but also do so with a deep-seated respect for patient privacy and consent throughout the entire process. We are working with AWS to reshape how technology can help to capture patient consent in a frictionless way and enable seamless longitudinal follow-up of patients to carry forward the knowledge gained from them in the future without compromising their privacy or personal data.

"Recognising the health inequities that exist in society, ZS is working with AWS to proactively develop socially responsible solutions to aim to ensure that the patients targeted for participation in the global R&D processes represent a truly equitable cross-section of society. By enshrining diversity in patient recruitment based on factors such as race, gender, age, and more, the industry can bring more

real-world diversity into processes and products."

Kapil emphasises the pivotal role of data-driven patient insights in driving healthcare innovation.

"Data is the key differentiator," asserts Kapil. "Collaborating with AWS and our own broader company processes prioritise accurate, timely, and real-world data to inform, improve, and accelerate decision-making across the value chain. However, the true excitement lies in the future potential of leveraging data with a patient-centric approach – whether deploying it to simulate disease progression or assess precise treatment decisions, harnessing data and artificial intelligence will empower the entire healthcare sector to deliver better outcomes for patients."

Chris underscores the importance of data in addressing major research and development (R&D) challenges in the life sciences sector, particularly the industrywide declining return on investment from innovation and the substantial costs associated with failure during the drug development process.

"R&D in the life sciences industry remains highly challenging," acknowledges Chris. "Over the past decade, we've witnessed a constant decline in the return on investment from innovation. There's immense pressure on the pharmaceutical industry to enhance efficiency and productivity, especially considering the rising costs of R&D. We estimate it takes $2-3bn to bring a new drug to market, and when factoring in the cost of failure, where only an estimated one in ten products make it through phase three trials, the total costs are staggering. Ultimately, the pharmaceutical industry needs to significantly improve overall efficiency and productivity in R&D."

Chris emphasises the pivotal role of data in addressing these challenges: "This is precisely where data can play a fundamentally important role in transforming the status quo. The life sciences sector handles massive volumes of data, from genomics to clinical trials, traditionally stored in on-premise environments. However, these environments are struggling to handle these demands and scale efficiently. From my perspective, this is one of the key advantages of the cloud, as only cloud-enabled technologies can effectively manage these massive data volumes. The cloud enables secure access to traditionally siloed internal and external data, enabling easy transformation of multimodal-multiomics data to uncover hidden insights in research data sets."

Expanding on the advantages of AWS's purpose-built data solutions, Chris elaborates: "Multiple purpose-built data solutions from AWS help customers make sense of all the data, enabling researchers with rapid data ingestion and processing. On top of this, you can apply advanced analytics, artificial intelligence, machine learning, and generative AI to transform data into actionable insights. For researchers, this is invaluable, as they are seeking more efficient and faster ways to make sense of data, run complex algorithms, simulate drug interactions or analyse longitudinal health data without any bottlenecks."

Addressing the growing importance of data collaboration, Chris states: "We are seeing in the industry that collaboration on data is becoming increasingly crucial. Many recent innovations in the life sciences industry stem from academia, necessitating seamless data collaboration between pharmaceutical companies and academic institutions, as well as within the industry itself. Collaborating on combined data sets is complex, as matching data securely often requires months of development time, and companies want to avoid sharing sensitive information.

“From the AWS side, this is why we have developed services like AWS Clean Rooms, which helps users more easily and securely analyse and collaborate on their collective datasets—all without sharing or copying one another's underlying data. This unlocks the true value of shared data – which is especially important for accelerating R&D.”

Building on the pivotal role of data in research and development (R&D) efforts, Dennis reiterates the burgeoning importance of artificial intelligence (AI) and machine learning for the life sciences industry.

"The promise and potential of AI and machine learning lie in their ability to decipher the intricate interactions between potential drug targets and human proteins," explains Dennis. "Being a biochemist by education, understanding the complex and often elusive nature of protein-protein interactions has always been the holy grail in our field. Unravelling

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Dennis Lauth, Head of Life Sciences Commercial Strategy & Solutions at AWS

the intricacies of these interactions requires a deep understanding of the structural and functional aspects of the proteins involved. By leveraging the latest advancements in deep learning and structural biology, AI models can predict the three-dimensional structures of proteins with unprecedented accuracy, even for complex and previously uncharacterised proteins. And now, we can perform very complex simulations, which might have previously taken days or even weeks, in a matter of minutes. This is only possible with the power of the cloud, high-performance computing, and the application of AI and machine learning, which allows researchers to rapidly analyse vast amounts of data, including vast repositories of scientific literature and experimental data, to identify patterns, generate novel hypotheses, and simulate potential drug-target interactions to generate and evaluate promising drug candidates, advance precision medicine, and ultimately accelerate discovery pipelines."

Chris reinforces the importance of data as a differentiator to leverage the value of AI and machine learning and the challenges the industry needs to be prepared for in terms of scale.

"When we discuss the benefits of precision medicine as a means of enhancing research and discovery, as well as accelerating clinical trials, we cannot overlook the significant data challenges," Chris asserts. "The sheer size of a single human genome, which can reach up to several gigabytes, highlights the immense storage and processing requirements for handling this deluge of genetic information. Moreover, the number of stored genomes is expected to grow exponentially, with estimates suggesting that by 2025, the total number of stored genomes could reach 100 million or more. As sequencing technologies evolve and improve, more and more data will be extracted from biological samples – further increasing the immense size of the raw data in only one example within the life sciences."

Chris emphasises the industry's imperative to seamlessly manage this data challenge.

"For the industry, it is imperative to manage this data challenge seamlessly – not only processing and storing it but drawing value from it as well,” says Chris. “That is why AWS has developed AWS HealthOmics, a purpose-built service that helps healthcare and life science organisations store, query, and analyse genomic, transcriptomic, and other omics data at petabyte scale and then derive insights from that data to improve health. It is great to collaborate with organisations such as ZS to bring these services to customers and help them tackle their most challenging data problems.”

A DELICATE BALANCE WHEN DEPLOYING THERAPIES

As therapies progress towards deployment, the focus shifts to ensuring patients gain timely access while balancing patient needs, improved outcomes, and the industry's commercial strategies. Here Asheesh, Kapil, Dennis and Chris explore this delicate balance.

Asheesh divides the deployment of therapies into three phases for serving patient needs and improving outcomes: ‘Get,’ ‘Start,’ and ‘Stay’.

"'Get' means finding the right patients for the therapies. 'Start' is ensuring they begin their journey with the treatment. 'Stay' refers to keeping them on track with the treatments and ensuring they are right for the patients," summarises Asheesh. "Within this, there are two interconnected aspects: the patient narrative and the provider narrative.

“The patient narrative involves navigating the ‘get, start, stay’ journey, while the provider journey unfolds in parallel, as they guide patients. Identifying potential patients in the ‘get’ phase leverages data capture across clinical care settings. Once identified, streamlining the onboarding experience through patient services is crucial, as an estimated 40% of patients never fill their first prescription due to systemic frictions. The ‘stay’ portion focuses on motivating patients to adhere to therapies, which may involve addressing pre-authorisations, side effect management, gamification or lifestyle changes. Simultaneously, providers must be aligned to drive optimal outcomes.”

According to Asheesh, joining the patient and provider narratives involves closing the gap between current practices and evidence surrounding new therapies or products.

"The industry is focusing its efforts on providers by engaging with them

to share compelling evidence and differentiated value new products or therapies bring to the market," says Asheesh. "It's all about convincing physicians to change their behaviours and adopt the best, evidence-based care practices – without friction, to secure the best care experience and outcomes for the patients.

“This process involves understanding providers' existing practices, inclination for change, learning channels, and overcoming obstacles to treatment adoption, such as patient access, reimbursement, and prescription writing. Leveraging data from multiple sources creates a ‘context stream’ around providers, enabling individualised influence rather than broad categorisations.”

Weighing in, Kapil emphasises the importance of a purposeful data strategy.

"A deeply considered data strategy is crucial," says Kapil. "What are we trying to drive from our use case? What are the interventions we're doing across the patient lifecycle? How can we refine our processes to enhance patient outcomes? Beyond the strategy, we then must take the underlying insights and build patient data products and solutions, weaving in AI and machine learning, to increase the value of these underlying datasets. We have to bring all of these things together to execute our vision."

Meeting patient needs must align with executing commercial strategies, explains Dennis. Solutions like the Intelligent Commercial Insights Foundation (ICIF) and Patient Analytical Hub (PAH) from ZS, running on AWS, are invaluable in this regard.

"Commercial teams need faster access to actionable insights, and this is still a

“WHAT ZS BUILT FOR CUSTOMERS WITH ICIF ON AWS IS A DATA MESH ARCHITECTURE TO MAKE IT VERY EASY FOR CUSTOMERS TO UNLEASH AND DEMOCRATISE THESE INSIGHTS, WHILE SIMULTANEOUSLY EMPOWERING THEM TO MAKE BETTER DECISIONS, FASTER”

Chris McCurdy, Chief Architect for Healthcare and Life Sciences at AWS

major struggle in the pharmaceutical industry," says Dennis. "We deal with more complex data now – it's not only first-party data from customer touch points. It's longitudinal health data, de-identified patient data, electronic health records, claims data, real-world evidence, and many other sources. All those data need to be ingested and made comprehensible. Modern business users demand agility, speed, and accurate data quality to generate actionable and timely insights at their fingertips."

Chris adds, "What ZS built for customers with ICIF on AWS is a data mesh architecture to make it very easy for customers to unleash and democratise these insights, while simultaneously empowering them to make better decisions, faster."

“ZS has also built solutions like Patient Analytical Hub (PAH) for customers to manage the complex patient data ecosystem and provide a foundational environment for securely integrating data sources and configuring business rules and data quality checks. This enables the right foundation data layers to enable sophisticated patient analytics,” adds Asheesh.

Beyond deployment, nurturing relationships with patients involves dynamics beyond purely medical factors.

"We need to pay close attention to patient outcomes after delivering new therapies,” says Asheesh. “Of course, we heed the clinical marker-based progression to see if therapies are effective. But there is more to this than a purely clinical focus – and we call this process non-medical marker-based tracking.

“This includes monitoring healthcare resource utilisation, disease burdens, quality of life, generating real-world evidence, and addressing non-medical factors like personal, social, and economic determinants of health. Solutions like ZAIDYN™, developed

with data partners on AWS, aim to address care gaps and health equity by creating a level playing field."

Wrapping up our conversation, Dennis circles back to the concept of placing the patient at the centre of the healthcare industry.

"When we think about this end-to-end patient journey, with all the intervention points along the way and opportunities to unleash data to better help patients, the last crucial piece of the puzzle is to think beyond point solutions," summarises Dennis. "Integrated healthcare solutions offer numerous benefits by breaking down traditional siloes, facilitating better information sharing, coordinated care, and personalised interventions. This can lead to earlier detection, more effective disease management, improved patient engagement and adherence."

Dennis emphasises the importance of integrating solutions into provider workflows.

"If the solutions are not seamlessly accessible for the providers, they will fail," Dennis warns. "If the solutions are integrated into core elements like electronic health records or daily use workflows, you reduce the friction from the provider side to use the digital health solutions. Only by making it frictionless for patients, providers, and other healthcare stakeholders can you unlock the full potential of integrated care, leading to improved patient outcomes, increased efficiency, and a more sustainable healthcare system."

Looking ahead regarding the future of ZS and AWS's work together, Asheesh believes there is no limit to the potential.

"We are doing a fantastic job leveraging AWS technology" says Asheesh. "Our goal for the future is to strive even further along this path with AWS to build cloud-enabled, integrated solutions for patients and their providers, addressing the fragmented nature of healthcare today while also helping the industry modernise their entire value chain with data and technology."

Dennis highlights the shared objective as the driving force behind the collaboration's success. "The most important thing is to have the same purpose. What I love about our collaboration with ZS is we are driven very much by a joint belief that technology has the power to make healthcare better, faster, more equitable and more sustainable."

Chris echoes the sentiment, emphasising the focus on seamless deployment and customer empowerment. "We will continue to work with ZS to innovate as they bring solutions for healthcare and life sciences that aim to transform the industry along the entire value chain," says Chris. "We also want to develop solutions that are seamless for customers in terms of deployment on top of their existing IT infrastructure.

"ZS's solutions being deployed in the customer's AWS environment is a strength, allowing customers to better control and own the solution roadmap for further evolution and enrichment while enabling cost-effective scaling and the needed flexibility to customise, drive adoption, and integrate with their existing capabilities. We believe that in order to address all the significant challenges the industry is facing, customers need to build comprehensive enterprise capabilities with the help of partners and then enrich and scale from there to empower use cases along their unique value chains to create the intended impact."

To learn more about ZS and AWS, visit their websites: zs.com and aws.amazon.com.

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Published by iThink media