

Focus

- Imaging is a core component of the MS PMCOE
- Analysis of images derived from clinical care is hampered by logistical, technical, and regulatory challenges
- PMAP allows the MS PMCOE to collect, curate, and analyze images stored in clinical systems

Method & Analytics

- The MS PMCOE MR imaging projection includes >14,000 patients and >70,000 MR imaging sessions
- DICOM images were selected for projection from the vendor neutral archive (VNA) using specific procedure codes for MRIs regularly used in MS care
- Images are projected from the VNA to Azure Blob Storage for use in analysis (totals 5.79TiB of data)

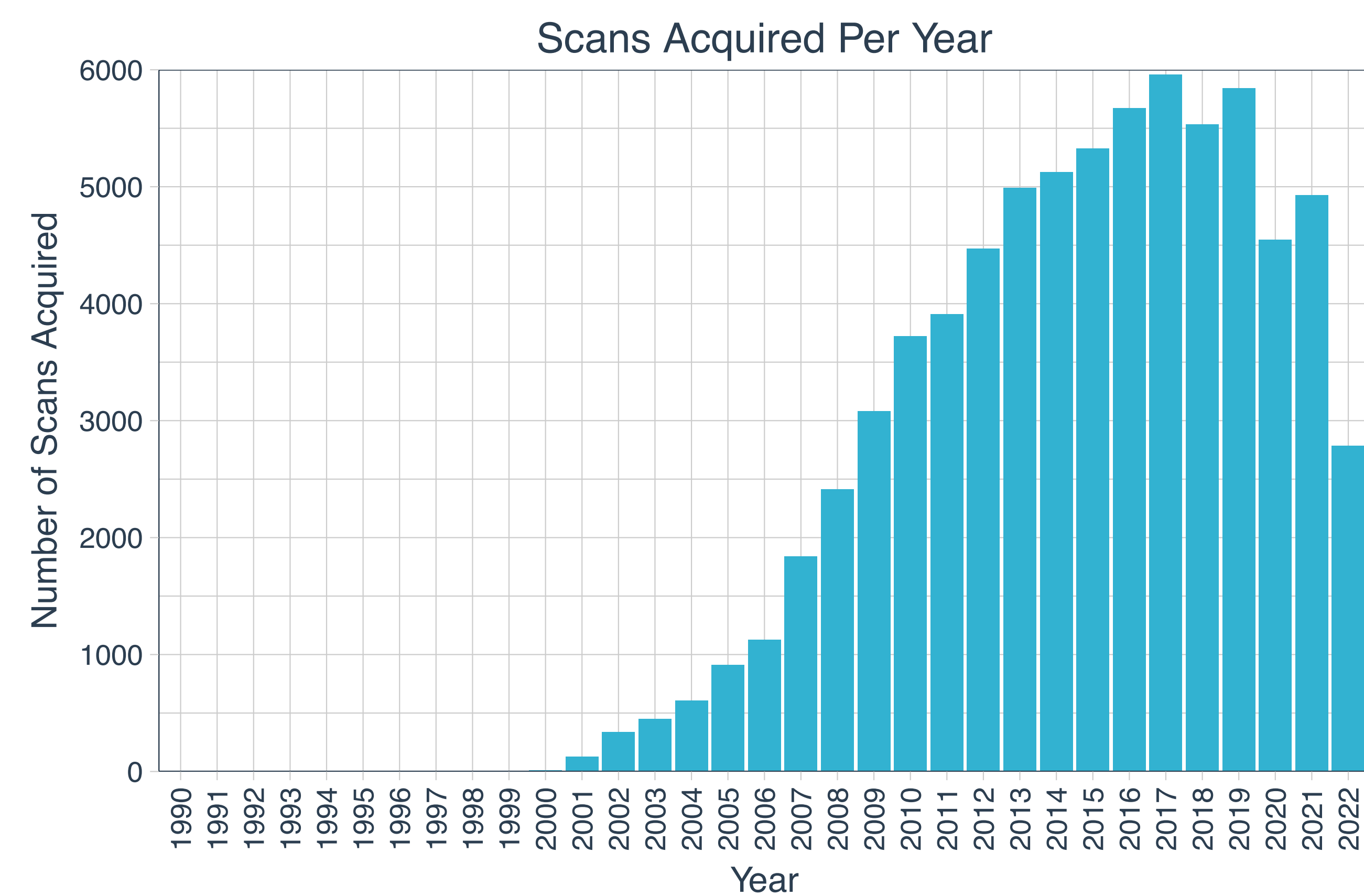


Figure 1: Number of scans in the MS-PMCOE imaging projection for each year. A small number of scans were acquired before 2001 but are not visible in this figure. 2022 represents Jan-Aug

Results and Highlights

- The rapid increase in scan availability in recent years is shown in Figure 1, with nearly 6,000 scans acquired in some years (also see the effect of the COVID-19 pandemic in 2020 and 2021)
- The potential for longitudinal analysis is shown in Figure 2. While many patients have little or no follow-up imaging, there are $\approx 3,800$ patients with ≥ 5 years, $\approx 1,600$ with ≥ 10 years, and ≈ 400 with ≥ 15 years follow-up

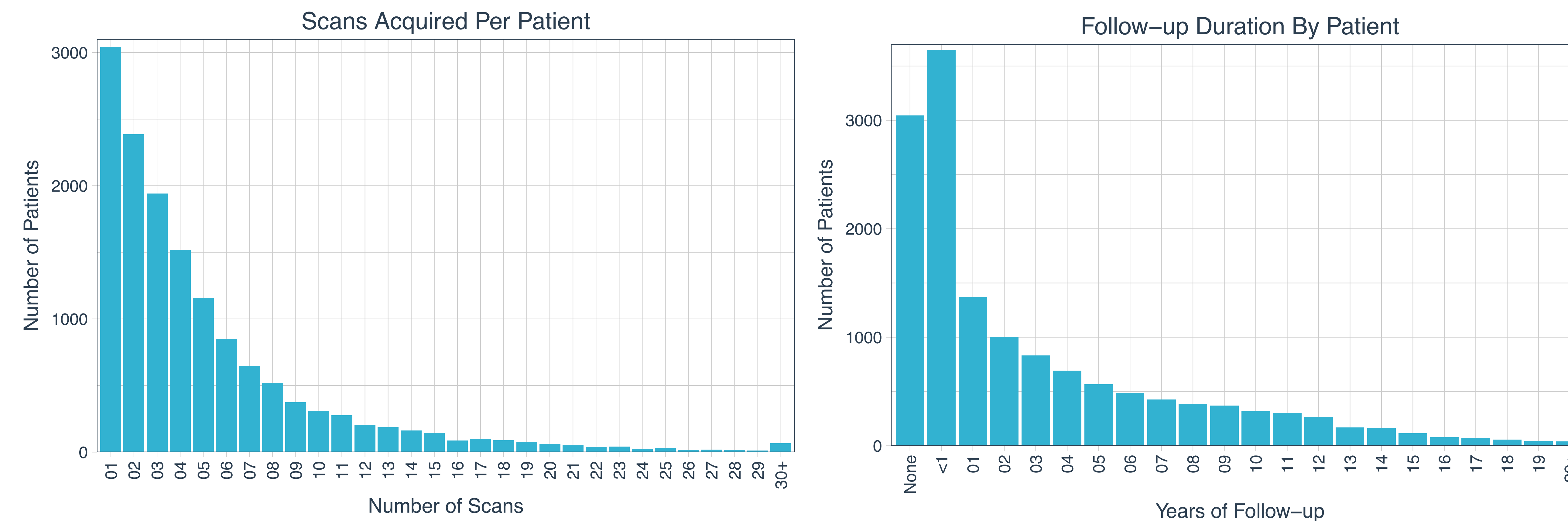


Figure 2: Histograms of the number of scans acquired (left) and length of imaging follow-up duration (right) of patients in the MS-PMCOE. For follow-up duration, “None” refers to patients that only have one scan (no follow-up).

- Historical scans have varying quality. Since 2015, the MS Clinic implemented standardized scanning (JH MS). JH MS scans increase from $\approx 10\%$ of brain scans in 2015 to $\approx 41\%$ in 2022 (Figure 3).

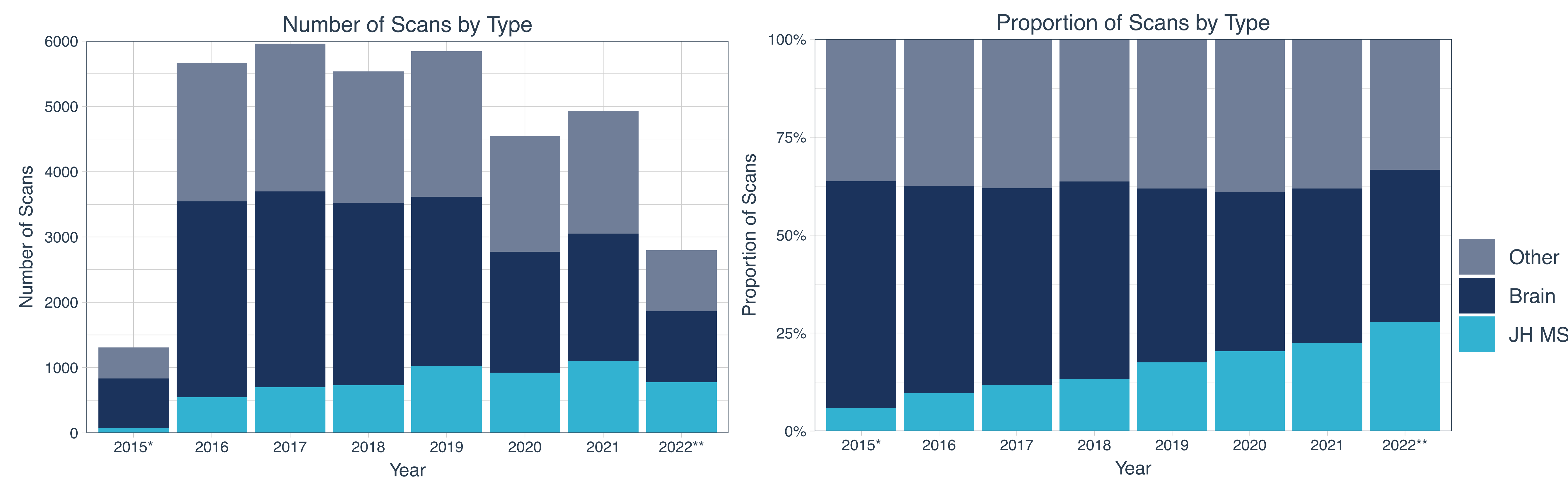


Figure 3: Histograms of raw scan counts (left) and normalized proportions (right) in the imaging cohort by year (2015-2022). Histograms are divided into standardized (JH MS), brain, and other scans (such as spine scans). *2015 represents Oct-Dec. **2022 represents Jan-Aug

Conclusion

- The MS PMCOE has a defined imaging cohort for investigation of neuroimaging outcomes in MS
- The cohort continues to acquire 1000s of images per year with history of >20 years
- Most patients in the cohort have follow-up imaging enabling longitudinal analysis
- Image quality is highly variable, especially across time, but standardized scans are becoming more popular

Next Steps

- Imaging in PMAP is being transferred to a XNAT instance for future processing
- In-depth investigation of the images to triage images based on quality
- Triaged images will guide technical research for incorporating historical data
- Analysis will begin on standardized scans to produce initial imaging outcomes

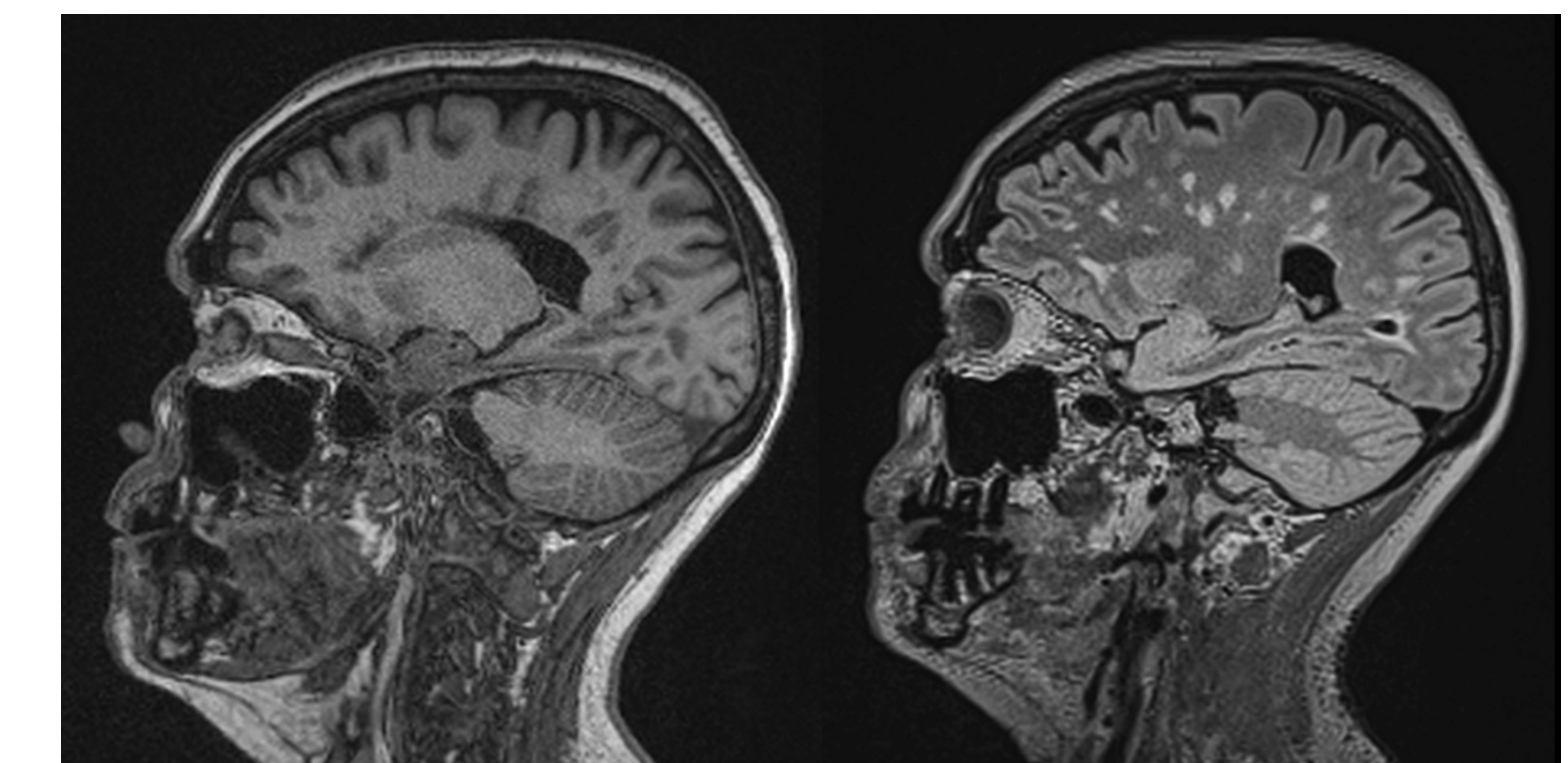


Figure 4: Example 3D high-resolution T₁-weighted (left) and T₂-FLAIR (right) images from an MS patient in the imaging cohort. These images are representative of the standardized MS MRI protocol.