
MEDICALNARRATIVES: Connecting Medical Vision and Language with Localized Narratives

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Abstract

Multi-modal models are data hungry. While datasets with natural images are abundant, medical image datasets can not afford the same luxury. To enable representation learning for medical images at scale, we turn to YouTube, a platform with a large reservoir of open-source medical pedagogical videos. We curate MedicalNarratives, a dataset 4.7M medical image-text pairs, with 1M samples containing dense annotations in the form of spatial traces (and bounding boxes), and 118K videos centered on the trace event (with aligned text), enabling spatiotemporal grounding beyond single frames. Similar to *think-aloud* studies where instructors speak while hovering their mouse cursor movements over relevant image regions, 1M images in MedicalNarratives contains localized mouse traces in image pixels, creating a spatial and temporal association between the text and pixels. To evaluate the utility of MedicalNarratives, we train GENMEDCLIP with a CLIP-like objective using our dataset spanning 12 medical domains. GENMEDCLIP outperforms previous state-of-the-art models on all 12 domains on a newly constructed medical imaging benchmark. [\[Data\]](#)

1 Introduction

Analyzing medical images requires simultaneous spatial localization and semantic understanding Morita et al. [82]. An expert has to extract visual clues from image regions and combine them with retrieved knowledge from memory, arriving at a diagnosis. This process requires connecting individual spatial image regions to clinical concepts, often utilizing a segmental approach to avoid errors. [82]. In medical image analysis, typically semantic tasks like classification, captioning, and retrieval are explored exclusively from spatial tasks like detection [96, 129, 113], or segmentation [127, 25]. This can be attributed to the lack of large grounded multimodal datasets to train such models. Recent work like MedTrinity-25M [128], attempts to address this by releasing a multimodal dataset with spatial annotations, but relies on sub-optimally pretrained models to generate text descriptions and Regions of Interests (ROIs) for medical images lacking ground truth annotations, potentially propagating model biases and errors.

While data collection costs are steep, certain protocols balance ease of collection and training utility. Specifically, Localized Narratives [96, 122] proposes a dataset of image, text, and grounding traces, curated by leveraging human annotators to describe an image vocally while simultaneously moving a computer mouse to the regions they describe, resulting in holistic grounded descriptions. This

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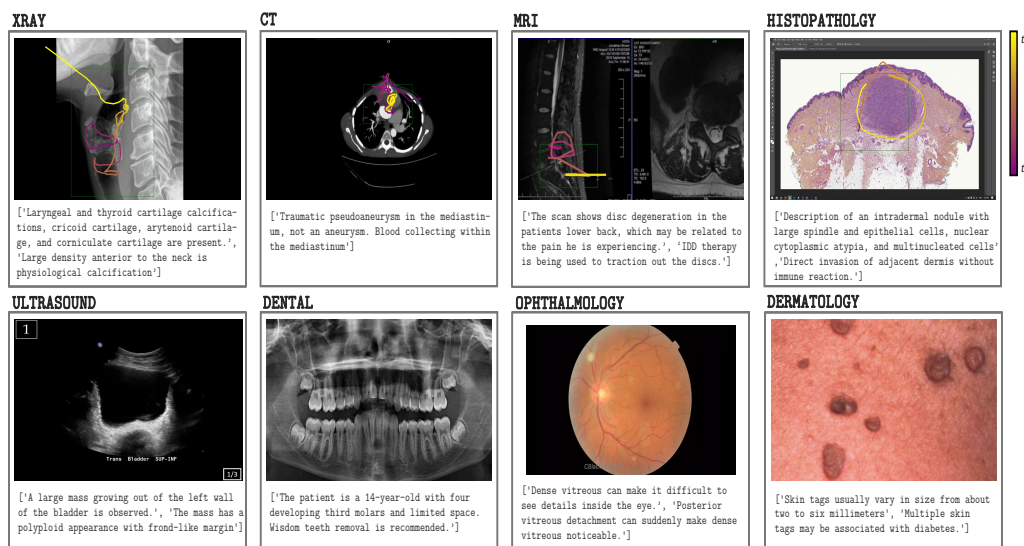


Figure 1: **MEDICALNARRATIVES**: Examples from our medical imaging modalities, excluding surgery, endoscopy, and general medical images due to their graphic nature. These samples are selected from interleaved video samples, with each sample showing the image, denoised text, and spatial traces & bbox aligned in-time on 4 domains. See section E in the Appendix for more examples and raw input text.

protocol of collecting grounded vision-language (VL) datasets does not have strict spatial annotations, yet, it captures strong spatial correlations to the description with every trace point, making the protocol uniquely easier to undertake and capture data en-mass as it appeals to the human nature to point while describing a scene [60, 123, 45]. Localized narratives have been used to train models on semantic tasks [96, 122, 133], and spatially-aware multimodal language models (MLM) like PixelLM [129], and Molmo [31] and other generative image models [68, 131].

To address these limitations, we draw inspiration from how medical experts naturally communicate and teach. In the joint field of cognitive psychology and medical imaging, studying how medical experts analyze patient data, studies leverage the think-aloud protocol [34] to capture data for various types of analysis, where experts verbalize their thoughts as they perform a task, and some studies capture their eye gaze/cursor localizing the image regions they focus on [74, 48]. This protocol has been used to collect medical datasets [92, 81], including the Tufts dental x-ray database [92], which captures a multimodal dataset incorporating radiologist expertise through eye-tracking and the think-aloud protocol.

We propose **MEDICALNARRATIVES** a dataset that leverages pedagogical medical videos where instructors narrate descriptions while pointing to relevant regions with their cursor, closely mimicking the think-aloud protocol used in clinical practice and the Localized Narratives protocol. Our dataset contains 4.7 million image-text pairs across 11 medical modalities and 1 pseudo-medical domain, with interleaving samples between varying modalities (e.g., X-ray and CT for the same patient), which we argue improves downstream performance as these samples connect multiple visual and textual concepts. Importantly, 1M of these samples are grounded in expert traces that can be reformatted into bounding boxes or masks (see Figure 5), serving as pretraining data for various tasks.

To test the base utility of our dataset, we train a vision-language model (**GENMEDCLIP**) on our dataset and evaluate it on a new benchmark of datasets that cut across 11 medical modalities. On both classification and retrieval, we see our trained **GENMEDCLIP** model outperform prior SOTA models like **BIOMEDCLIP** in both tasks with an average of 3% and 14% respectively. While the proposed dataset is a combination of data from **A**. Temporal unstructured sources like video, and **B**. Static structured sources like scientific articles, unlike prior work that solely leverage one source, our experiments show that the utility of the dataset increases with more data from video, with a net difference of 11.65% on classification tasks and 53.6% on zeroshot retrieval tasks. Finally, we show

the utility of traces with qualitative examples, converting traces into segmentation using pretrained interactive medical image segmentation (IMIS) models like ScribblePrompt [127, 25]. We hope future works leverage the dataset to train more grounded generative models similar to Quilt-LLaVA [113], LLaVA-Med++ [128], and PixelLM [129] as well as spatially-controlled medical image captioning models [96]. To bolster other use cases, we also release the constituting video clip IDs (useful for obtaining the videos) and many other metadata, including modality type and UMLS entities.

In addition to the centered still images with traces, we provide paired videos (temporal windows around trace start/end), preserving narration alignment to the pointing behavior. This addition allows models to learn spatiotemporal grounding (e.g., cursor trajectories across frames) rather than static spatial associations alone.

2 Related work

2.1 Vision Language representation

Vision-language (multi-modal) models have evolved over time in both supervised and self-supervised paradigms; in recent studies, contrastive self-supervision objectives [98, 135, 56] that learn by matching paired-modality embeddings have outperformed prior work [77, 72, 24] in downstream tasks and, more importantly, perform better at zeros-shot tasks or on emergent domains for which disparate modalities share a paired domain [39, 139]. In medical imaging, early studies in radiology [135, 50] were pre-trained on specific x-ray images and their reports, and more recently domain specific VL models have pushed the SOTA on various tasks with models developed for Ophthalmology [114], Histopathology [53, 51], Computed Tomography [47], Mammography [23], Dermatology [67], Ultrasound/Echocardiography [26]. These models work well for the specific domains they are trained on and not for other domains, which may not have enough data to train for, hence the push for more general medical models [134, 138, 119].

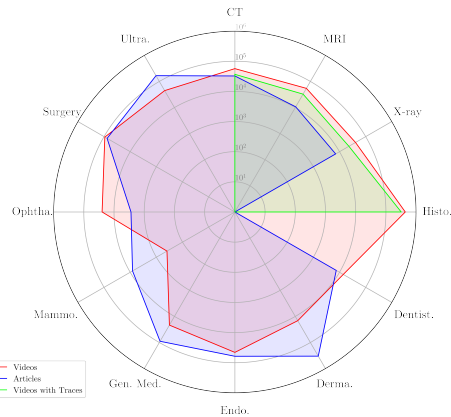


Figure 2: Breakdown of MEDICALNARRATIVES in size by modalities across both video and article subsets.

2.2 Medical (Localized) Narratives

In training these VL models, much research effort is used in sourcing, filtering, and curating medical image(s)-text(s) paired data for pre-training, mostly sourcing general and specific medical domain datasets from Medical reports [59], PubMed [35, 105, 36, 134], books [36], social-media [51, 53], YouTube/videos [53, 113] or mixtures of these [128].

The utilization of these data for dense tasks like segmentation and detection (open-closed vocabulary) is limited as they do not provide any spatial annotation localizing regions of the images to specific labels/text. In contrast, every word in a localized narrative [96, 122, 133, 113] is grounded to a

Dataset	Size	Source	Medical Only	Domains	Open Source Data/Code	Novel Images	Video	Text	Spatial Annot.
PMC-15M [134]	15M	A	✗	30	✗/✓	✓	✗	Captions	✗
PMC-FG-64M [134]	46M	A	✗	30	✗/✗	✓	✗	Captions	✗
PMC-CLIP [73]	15M	A	✗	12	✓/✗	✓	✗	Captions	✗
MedTrinity-25M [128]	25M	P	✓	10	✓/✗	✗	✗	Captions/labels	Seg. mask
MedicalNarratives	4.7M	V+A	✓	12	✓/✓	✓	✓	Expert	Traces

Table 1: **Comparison with large-scale medical datasets.** In the table, A: Articles, V: Videos, and P: pre-published datasets. Open-Source column is formatted *data/pipeline*.

region of the representative image by the point/trace captured. This datasets have been used to train models for semantic reasoning [96, 122, 133], and for dense tasks [41, 38, 32], and they also support training both generative multimodal language models [129, 113, 122] and generative image models [68, 131]. Specifically in medical image analysis, Quilt-LLaVA [113] adopts this paired data structure for training its histopathology chatbot with improved spatial reasoning, and Pathnarrative's [133] hierarchical decision-to-reason localized narrative structure, enables classification and captioning tasks, offering explainable insights that improve human-AI collaboration in pathological diagnosis.

3 MEDICALNARRATIVES:

Curating a vision-language dataset with spatial traces from unstructured pedagogy videos is a non-trivial, as many videos either lack voiced audio, fail to contain medically relevant content, or have insufficient medical relevance. In addition, conventional automatic speech recognition (ASR) systems also struggle with the specialized requirements of medical language transcription, necessitating a non-trivial solution. The de-noising of text and image modalities adds further complexity as the videos are typically conversational and, therefore, inherently noisy. Instructors often record both relevant and irrelevant visual content in their videos, making extracting frames at static intervals non-representative of the medical data contained in the video.

To collect MEDICALNARRATIVES, we leverage insights from Quilt-1M [53] prior work, we trained models and handcrafted algorithms that leverage the nuances in the instructors' textual and visual behavior, ensuring accurate collection and alignment of both modalities. Finally, we manually filter noisy samples out and employ other heuristics and models to remove artifacts like faces and irrelevant traces. In this section, we start by characterizing the dataset 3.1, then we discuss the methods used to source and filter the dataset 3.2, localize traces 3.3, and discuss the implicit interleaving property 3.4. See Figure 3 for our pipeline and section A and B of the appendix for how we align the data samples A.5.

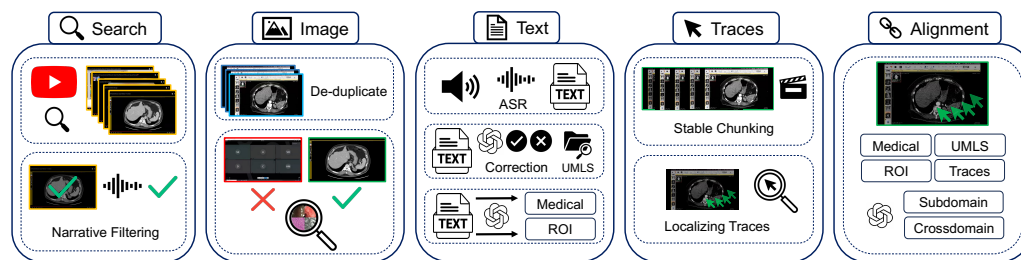


Figure 3: The data curation pipeline for the Video subset of the MEDICALNARRATIVES dataset. **Search:** YouTube video-first search strategy, with filtering by pre-trained classifiers and heuristics. **Image:** Extracting keyframes of a video, denoising, and identifying medical images. **Text:** ASR transcription, text correction with LLMs, and medical/ROI text extraction. **Traces:** Identifying stable chunks of a video, then localizing cursor traces within each chunk. **Alignment:** Mapping medical/ROI text, traces, and images together. Samples are classified into finer-grained subdomains, and samples with discussions of multiple domains are identified with LLMs.

3.1 Characterizing MEDICALNARRATIVES

To create MEDICALNARRATIVES we combine medical narratives curated from videos with image-text pairs curated from PubMed, resulting in 4.7M total image-text samples of which 1M samples are localized narratives. We compare our dataset against other medical pretraining datasets in Table 1 across various key distinctive properties including data source, and spatial annotation. Figure 2 shows the distribution of MEDICALNARRATIVES across various medical modalities, and Table 9 and Table 10 in the appendix give detailed statistics across all medical modalities.

3.1.1 Video-Subset

We searched over 738K videos and extracted 74K narrative-styled videos that passed our heuristics and had relevant medical imaging pedagogy, a 10.1% yield making up a total of 4526 hours of video.

In total, we collect 736K unique images with an average size of H: 1493px and W: 923px and 1.63M image-text pairs from videos with 1M of these samples grounded with traces, these samples cover 101.8M number of unique trace points yielding 547K number of unique bounding boxes with an average size of H: 316px and W: 357px across the 4 domains with traces: CT, MRI, X-ray, and Histopathology. The dataset contains 118K videos, collected at the boundaries of the traces, with a min, max, and average duration of 3.3, 228.8 and 24.2 seconds. The mean length of the text captions is 29.87 words, with an average of 2.48 medical sentences per image. Our dataset spans over 4M UMLS entities from those mentioned in the text with over 300K unique entities across medical (e.g., findings, or disease) and non-medical (e.g., governmental or regulatory activity) semantic types.

3.1.2 Article Subset

We extract 5.4M articles from PubMed [86], with 23M figures, after filtering for medical figures only, we obtain 1.03M figures from 273K articles, and after sub-figure separation, we have an average of 2.62 subfigure-subcaption pairs per-article figure, with an average of 45.45 words per-caption.

3.1.3 Quality

Unlike localized narratives [96, 122] where localization accuracy can be measured by comparing against human annotation, none of our videos to our knowledge have any structured human spatial annotation to compare against. Nonetheless, to evaluate our pipeline's performance, we assess several aspects. First, we calculate the precision of our LLM's corrections by dividing the number of conditioned misspelled errors replaced (i.e., passed the UMLS check) by the total number of conditioned misspelled words found, yielding an average of 47.99%. We also determined the unconditioned precision of the LLM, similar to the previous step, and found it to be 17.58%. Therefore, we replace our detected incorrect words with the LLM's correction 47.99% of the time, and 17.58% of the time we replace the LLM's detected errors with its correction. To estimate the ASR model's transcription performance, we compute the total number of errors replaced (both conditioned and unconditioned) and divide it by the total number of words in each video, resulting in an average ASR error rate of 0.81%. Also note that, by prompting the LLM to extract only medically relevant text, we further eliminate identifiable information, such as clinic addresses, from our dataset.

Since the dataset was collected for pretraining, we do not upsample the text after correcting for errors and filtering bad images; on average, each image is paired with approx. 83 words of relevant text and traces when available and validated.

3.2 Data Sourcing and Filtration

This involves (a) sourcing video/article data across 12 medical imaging domains, (b) filtering videos/articles, (c) denoising the captured images, captions, and trace modalities, and (d) aligning all modalities. We detail our method and highlight key contributions in sections A and A of the appendix.

3.2.1 Text Extraction and Denoising

Videos: In line with Quilt-1M [53] we leverage an open-source ASR model - Whisper [99] to transcribe all speech from the selected videos, correcting transcription errors using language model with specialized prompts (see section A.4 for details on the error-extracting algorithm).

Articles: Similarly we parse each article's XML document, extracting each figure's caption and inline mentions (see B.1). Since many sub-figures are typically grouped into single large figures, we split the compounded figure captions into sub-captions, leveraging an LM to find and split sub-captions due to the non-triviality of identifying enumerations in the text and splitting the captions correctly (see B.4). Furthermore, we refine the inline mentions of a figure and match them to specific sub-captions/sub-figures (see B.6).

3.2.2 Image Extraction and Denoising

Videos: For each video, we identify medical key-frames and subsequently leverage these frames' times to split the video into time-intervals called *chunks* from which to extract representative image(s). To extract representative image(s), we use the median image of stable frames in each chunk if they

exist, else we de-duplicate the captured key-frames, exploiting the human tendency in pedagogy videos to pause while explaining and pointing [96, 45, 113].

Articles: For scientific documents, we extract the figures as images. However, many of these figures contain multiple sub-figures which can take nonconventional grid shapes and are labeled irregularly, making the task of splitting into sub-figures and pairing with the correct sub-caption non-trivial. Since most compound figure layouts are not uniform and vary in the whitespace in between sub-figures, we train an object detection model based on the YOLO architecture [58] on sub-figure annotation datasets MedlCaT and ImageCLEF 2016 [117, 37]. See more details in section B.3

3.3 Localizing Traces in Videos

Extracting the trace/cursor location from medical clips poses a significant challenge due to certain domain properties including homogeneity in color and texture, significant black/white background, and presence of artifacts in videos such as minor pixel variations and variations in the narrators' cursor movement speed and style. We modify the methodology proposed by Quilt-LLaVA [113] centered around the observation that narrators typically pause before signaling with their cursor. We isolate segments in the video where the background is static, termed stable chunks. To do so, we develop a frame-differencing approach to detect chunks with minimal background movement. Our algorithm computes the absolute difference between consecutive frames and then applies a Gaussian filter for adaptive thresholding to detect frames with minor changes.

Due to the homogeneity of medical images, naive pixel-wise differencing produces many false positives, misidentifying changing chunks as stable. To mitigate this, we incorporate a perceptual metric, using the structural similarity index measure (SSIM) on randomly sampled patches to verify frame changes. Next, for each stable chunk, we compute a median frame (in the pixel domain) as a background reference, subtract it from individual frames, and apply a threshold to isolate the cursor. We then extract trace points by identifying the maximum pixel value coordinates. This method assumes minimal background motion, but subtle movements, such as narrator facial expressions, can interfere. To address this, we apply a face detection model [111] to mask distractions, ensuring focus remains on cursor movement. This algorithm provides a robust and generalizable approach for capturing cursor traces from medical videos.

Extracting videos

For each detected trace segment we extract the video clip at the start and end of the trace temporal window aligned with the text.

3.4 Cross-Modal Interleaved Samples

A key advantage of MEDICALNARRATIVES is its interleaved multi-modal nature. This manifests in two ways: (1) **Video-based interleaving:** Medical pedagogy videos frequently present multiple imaging modalities for the same patient. Instructors naturally explain relationships between these modalities in a single narrative, creating one-to-many mappings between textual descriptions and images. This allows our model to learn connections between modalities through shared textual context (see Figure 9 in Appendix). (2) **Sample-based interleaving:** Articles and Videos often contain images with multiple sub-images showing different modalities accompanied by a unified caption. This structure similarly reinforces cross-modal relationships. (see MRI example in Figure 1 and Figure 9 in the appendix). This interleaved nature of MEDICALNARRATIVES significantly enhances cross-modal retrieval capabilities, as shown in Sec. 4.4. We open-source our dataset with modality tags which can be used to identify cross-modal samples.

4 GENMEDCLIP: Experiments

We test the utility of MEDICALNARRATIVES on two medically relevant tasks image classification (zeroshot and linear probing) and cross-modal information retrieval (zero-shot) across all in-domain modalities. We select the Contrastive Language-Image Pre-training (CLIP) objective [98] to pre-train a VL model: GENMEDCLIP. We train several models, varying the image, and text encoders while making adaptations in line with prior work on the choice of encoders and text tokenization for

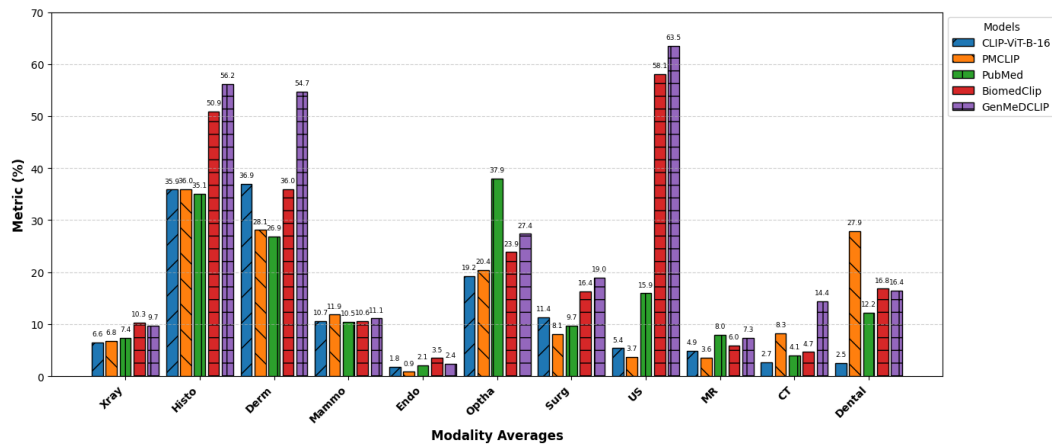


Figure 4: **Zeroshot Classification Results** shows that our model GENMEDCLIP outperforms all other baselines including the out-of-domain CLIP, and biomedical vision-language models BIOMED-CLIP, and PUBMEDCLIP across the constructed medical benchmark which covers all 11 medical domains represented. The metric for Xray and Mammography is mean average precision while the rest is accuracy.

improved performance [134, 53]. For the image tower, we finetune Vision Transformers (ViT-Base) [33] models pretrained using a supervised cross-entropy objective (ViT-Base-16 and ViT-Base-32 [126]) and unsupervised contrastive objective ViT-Base-16) [98], on 224*224 pixel images. On the text tower, we use GPT2 [97] with a context length of 77, and BioMedBert [44] with context size to 256. To train our models we utilize OpenClip [54] on 4 Nvidia A40 GPUs for 20 iterations. To ensure a fair comparison with baselines, we trained three different variants of our model: GENMEDCLIP-32: with ViT-B/32 image-tower and GPT2/77 text-tower architecture, GENMEDCLIP-PMB: with ViT-B/16 image-tower and Bert/256 BioMedBert [44] text-tower, and GENMEDCLIP-PMB: with ViT-B/16 image-tower and GPT2/77 [44] text-tower; all finetuned for 20 epochs over our train-set, while data split ablation models are trained for 6 epochs. (Details in Section D in Appendix.)

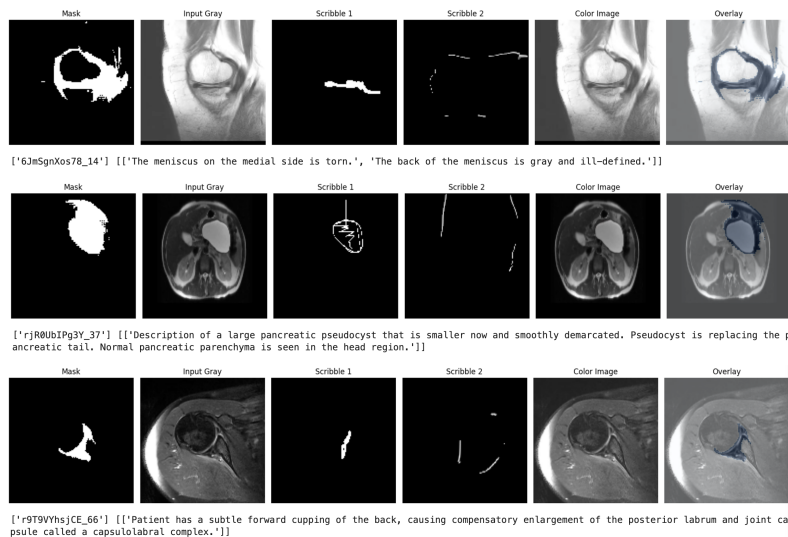


Figure 5: Using trace as prompts for segmentation using ScribblePrompt-SAM. (Right) resulting mask from trace (Center).

Model	Isic	Til	Pcam	Mhist	Nck	Mammo	Avg
CLIP-ViT-B-16 [98]	71.23	91.23	82.42	63.97	92.26	83.30	80.74
PUBMEDCLIP [35]	68.58	91.32	84.07	72.16	92.29	83.90	82.06
BIOMEDCLIP [134]	68.25	91.82	83.43	66.73	93.05	83.70	81.17
GENMEDCLIP-32	72.75	93.26	86.77	72.06	92.77	83.70	83.55
GENMEDCLIP-PMB	69.38	91.51	84.54	67.66	88.02	84.20	80.88
GENMEDCLIP	74.87	93.34	87.69	72.16	90.84	84.90	83.97

Table 2: **Linear Probing** results across datasets representing Dermatology (Isic), Histopathology (pcam, mhist, nck), and Mammography (vinDr-Mammo) classification tasks. GENMEDCLIP outperforms all baselines showing the capacity of our model to be fine-tuned for downstream tasks. The metric used is accuracy.

4.1 Benchmarking on Downstream Medical Tasks

We evaluate the utility of GENMEDCLIP on a new medical imaging benchmark of all medical domains represented in our pre-training dataset MEDICALNARRATIVES, with some domains represented by ≥ 1 dataset/task for classification, totaling 29 downstream datasets and on a held-out set of 1000 unique images for the retrieval task downstream. For MRI, CT, and ultrasound we use their respective subsets from **RadImageNet** [80] dataset. For Xray, we evaluate on **VinDr-CXR** Chest Xrays [87] test set and report the mean average precision (mAP), similarly for Mammography we use **VinDr-Mammo** [88] and report the mAP. We evaluate surgical organ classification using **Dresden** [21], and for endoscopy, we test on all procedure images in **GastroVison** [55]. For Dermatology we evaluate on the **Diverse Dermatology Images** (DDI) [30] binary (benign or malignant) dataset and Isic 2018 dataset [27]. For Dentistry we evaluate on **Dental orthopantomography** (OPG) [100] X-ray dataset. To evaluate the Ophthalmology domain we evaluate on **G1020** [13] a retinal fundus glaucoma dataset and on **Optical Coherence Tomography Dataset** (OCTDL) [70]. We evaluate the Histopathology domain on the following datasets: **PatchCamelyon** [121], **NCT-CRC-HE-100K** [62], **BACH** [10], **Osteo** [12], **SkinCancer** [69], **MHIST** [125], **LC25000** [18], and on TCGA-TIL [109]. Please see section D in the appendix for more details.

Models	Data	T2I retrieval			I2T retrieval			Avg
		@5	@50	@200	@5	@50	@200	
CLIP-ViT-B-16 [98]	-	3.48	20.38	35.69	3.56	20.39	35.42	19.82
PMC-CLIP [73]	A	0.01	0.33	1.18	0.01	0.34	1.24	0.52
PUBMEDCLIP [35]	A	1.44	12.68	25.44	1.10	12.30	24.07	12.84
BIOMEDCLIP [134]	A	16.50	51.48	67.46	15.71	48.85	64.61	44.10
GENMEDCLIP-32	V+A	22.36	76.33	88.60	20.75	75.15	88.23	61.90
GENMEDCLIP-PMB	V+A	28.29	82.91	92.43	29.21	82.91	92.43	68.03
GENMEDCLIP	V+A	34.89	83.83	92.27	34.26	83.48	92.32	70.17
Data Split Ablation								
GENMEDCLIP *	A	2.11	12.89	22.36	2.35	13.66	22.81	12.70
GENMEDCLIP *	V+A	28.01	80.56	90.96	27.48	79.95	90.85	66.30

Table 3: **Retrieval** results on our held-out set of 16K samples across all medical domains, show that our model GENMEDCLIP outperforms all other baselines on both Zeroshot image-to-text and vice-versa text-to-image retrieval task. In the table, A: Articles, V: Videos, and * represents a shorter number of fine-tuning iterations

4.2 Zero-shot classification

We evaluate our model’s zero-shot performance against three state-of-the-art models: CLIP, BIOMED-CLIP, PMC-CLIP, and PUBMEDCLIP. In Figure 4 and Table 8, each domain in the benchmark is represented by a set of dataset(s). The prompts used for these evaluations are presented in Table 7 in the Appendix. Across the benchmark, our model averages the following GENMEDCLIP-32:

31.33%, GENMEDCLIP-PMB: 31.46%, and GENMEDCLIP: 32.55% metric all outperforming BIOMEDCLIP with 27.80% by 4.75%. Specifically, as shown in Figure 4, GENMEDCLIP outperforms all baselines in five medical domains: Histopathology, Dermatology, Surgery, Ultrasound, and CT, while remaining comparable to baselines in the Chest X-ray, Endoscopy, Mammography, and MRI domains.

4.3 Supervised linear probing

We assess the full-shot performance of our model by conducting linear probing with 100% of the training data; we report the average accuracy over all benchmark evaluation across five distinct datasets, specifically those with dedicated training and testing sets among our external datasets in Dermatology, Histopathology, and Mammography. Remarkably, our model, utilizing the ViT-B/32 architecture with GPT/77, outperforms its counterparts, BIOMEDCLIP, and CLIP, in most datasets. Overall, on average GENMEDCLIP outperforms all other models including BIOMEDCLIP and PUBMEDCLIP with over 2.8%, and over 1.9% respectively.

4.4 Cross-Modal Retrieval

We evaluate cross-modal retrieval performance by examining both zero-shot text-to-image and image-to-text retrieval capabilities. To do so, we leverage a randomly selected held-out partition of MEDICALNARRATIVES, not used in training our models. The held-out set contains 16K image-text pairs with the following medical modality distribution: 1756 X-ray, 1237 MRI, 1851 CT, 1351 Ultrasound, 1744 Surgery, 1346 Endoscopy, 1189 Dermatology, 1216 Dentistry, 1151 Ophthalmology, 1000 Histopathology, 1299 General Medical, 1149 Other (Mammo etc) image-text pairs. Retrieval in our study is done by identifying the nearest neighbors for each modality and then determining whether the corresponding pair is within the top N nearest neighbors, where $N \in \{1, 50, 200\}$, mimicking several medical search tasks. Results in Table 3 shows that on average GENMEDCLIP outperforms all baselines and specifically outperforms BIOMEDCLIP by 26.07%, The results also confirm the observation made in BIOMEDCLIP [134] where the general CLIP model outperforms the in-domain model PUBMEDCLIP by 6.98%

4.5 Data Split Ablation

As seen in Tables 8 and 3, we ablate the added utility of capturing pedagogy video data by training two models, one trained solely on articles and the other on both articles and video data. The results show that adding the video-derived data leads to higher average classification (11.65% higher) and retrieval (53.6% higher) performance. We suspect that the dynamic nature of *video frames* introduces diverse vantage points, partially explaining these improvements. We also see that classification performance across all Article only trained models except Biomedclip is comparable further buttressing the impact of video as a data source.

5 Discussion and Limitations

MEDICALNARRATIVES contributes a robust pipeline for grounded multi-modal data curation across noisy, unstructured, and diverse medical modalities sources. We believe it would catalyze progress in novel medical vision-language tasks, like spatially-controllable report generation [96, 129], and interactive medical image segmentation [25, 127]. Figure 5 illustrates how the captured traces, albeit noisy and not expert-validated, can serve as conditioning for semi-automatic segmentation models like ScribblePrompt [127] toward plausible object boundaries and for exploring visual grounding toward text+trace conditioned segmentation.

Spatial Reasoning Applications

Beyond retrieval/classification, the trace-aligned samples provide direct supervision for grounded language and localization tasks without dense masks. Following Localized Narratives [96, 122], each word/phrase co-occurring with a trace segment supplies weak phrase-region links for grounded captioning, referring expressions, and spatial relation inference. High-dwell (i.e. spatial regions where narrators focus on) segments of traces can be collapsed into pointing cues to train pointing-based

medical MLMs, such as Molmo [31]. Because our traces are timestamped, the same supervision naturally extends to video: the trajectory of the cursor across frames yields spatiotemporal grounding suitable for dynamic "point-while-describe" models and temporal localization (e.g., axial CT sweeps or ultrasound). The dataset also supports tasks that predict spatial traces as additional loss objectives toward imbuing models with spatial understanding [129] and panoptic narrative grounding objectives [41] are directly enabled by these trace–text alignments.

For dense prediction and controllable generation, traces act as sparse supervision that can be transformed into inputs for interactive medical image segmentation (IMIS) models (e.g., as points/scribbles for ScribblePrompt) to bootstrap pseudo-masks and iteratively refine them [127]. Coupling trace spans with their co-mentioned phrases supplies approximately localized phrase labels for open-vocabulary detection/segmentation similar to phrase-region training [32, 38].

Finally, the same signals can guide where and what to synthesize in text-to-image/volume models, using trace/point conditioning alongside clinical text to localize clinical entities, while enabling spatially controllable medical report generation [68, 131, 113, 129].

Limitations

1. Our dataset lacks human-annotated bounding boxes, limiting overlap assessment between video traces and annotations, restricting dense tasks like semantic segmentation.
2. Our dataset overrepresents abnormal cases, an underlying bias, reflected in hospital practices where imaging follows clinical suspicion. This may impact model generalizability and introduce bias in clinical decision support.
3. While we showcase the capacity of traces to be useful for IMIS task, this work does not leverage the traces to train any models toward downstream spatial or spatial aware models like PixelLM [129]. We leave this to future work.

6 Conclusion

This study proposes a robust protocol for collecting and annotating medical narratives. Our curated dataset MEDICALNARRATIVES, which follows the Narratives Annotation Protocol addresses the specific challenges of medical data collection at scale balancing the relationship between downstream utility and ease/cost of collection. We argue that this protocol can serve as the de facto standard for annotating future multimodal medical datasets, particularly given its flexibility in capturing grounded text describing medical images effectively. We demonstrate a strong performance over prior models, across both classification and retrieval tasks, establishing new state-of-the-art results and demonstrating the effectiveness of data filtration methods on model performance, as we train our GENMEDCLIP on 4.7 samples while BIOMEDCLIP trains on over 15M samples. We hope future work leverages our developed models, dataset, and protocol.

7 Acknowledgments

We thank Fateemeh Ghezloo for the initial discussions that led to this work. We thank Ranjay Krishna and Linda Shapiro for their writing contributions and support of the study. We also acknowledge Microsoft for providing OpenAI credits, and partial funding through a Population Health Initiative at University of Washington.

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