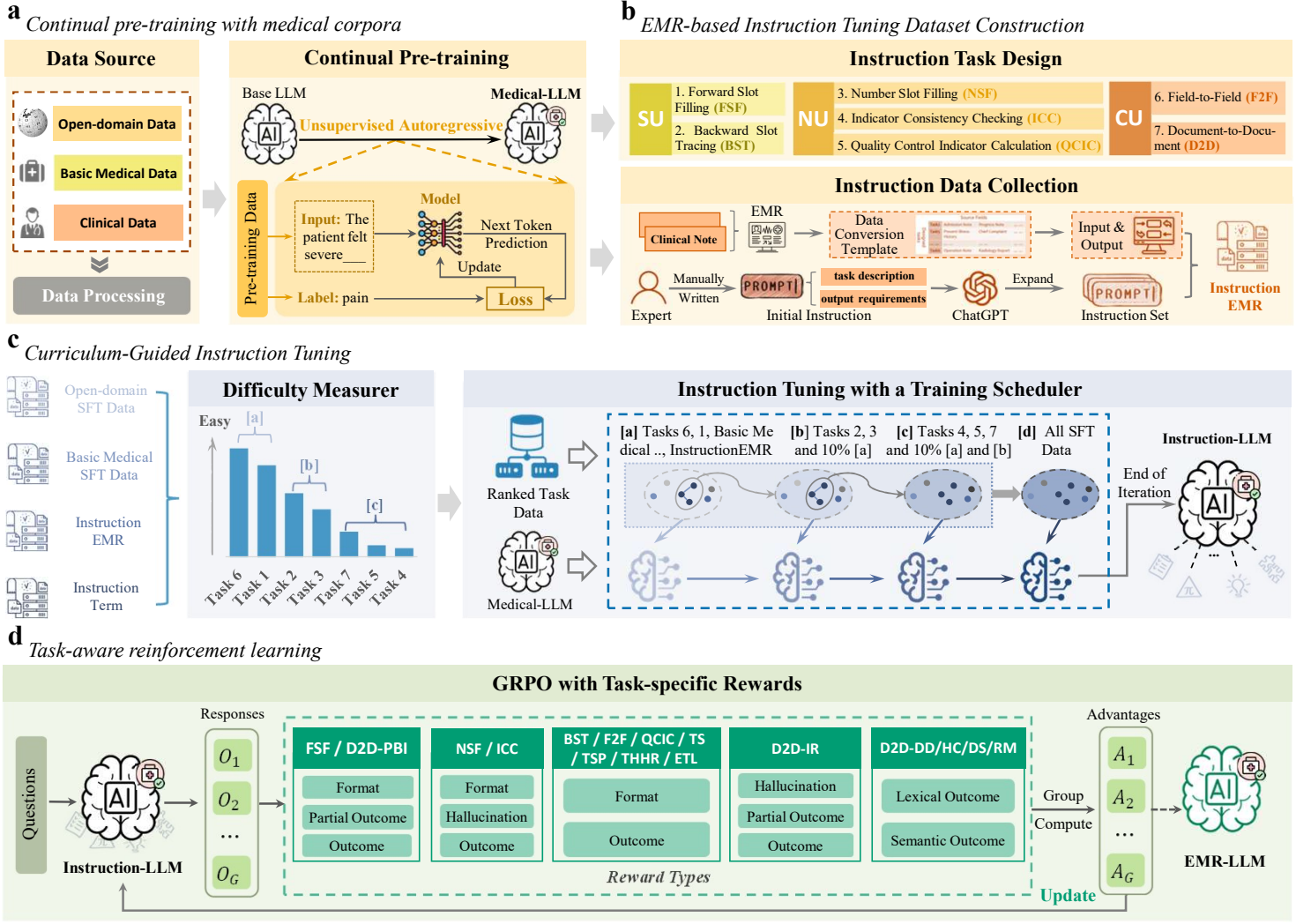
a
Continual pre-training with medical corpora
Data Source
Open-domain Data
Basic Medical Data
Clinical Data
Data Processing
Continual Pre-training
Base LLM
Medical-LLM
Unsupervised Autoregressive
Pre-training Data
Model
Input: The patient felt severe___
Next Token Prediction
Update
Label: pain
Loss
b
EMR-based Instruction Tuning Dataset Construction
Instruction Task Design
SU
1. Forward Slot Filling (FSF)
2. Backward Slot Tracing (BST)
NU
3. Number Slot Filling (NSF)
4. Indicator Consistency Checking (ICC)
5. Quality Control Indicator Calculation (QCIC)
CU
6. Field-to-Field (F2F)
7. Document-to-Document (D2D)
Instruction Data Collection
Clinical Note
EMR
Data Conversion Template
Input & Output
Instruction EMR
Manually Written
Expert
PROMPT
task description
output requirements
Initial Instruction
Expand
ChatGPT
PROMPT
Instruction Set
c
Curriculum-Guided Instruction Tuning
Open-domain SFT Data
Basic Medical SFT Data
Instruction EMR
Instruction Term
Difficulty Measurer
Easy
[a]
[b]
[c]
Task 6
Task 1
Task 2
Task 3
Task 7
Task 5
Task 4
Instruction Tuning with a Training Scheduler
Ranked Task Data
Medical-LLM
[a] Tasks 6, 1, Basic Medical .., InstructionEMR
[b] Tasks 2, 3 and 10% [a]
[c] Tasks 4, 5, 7 and 10% [a] and [b]
[d] All SFT Data
End of Iteration
Instruction-LLM
d
Task-aware reinforcement learning
GRPO with Task-specific Rewards
Questions
Instruction-LLM
Responses
O_1
O_2
…
O_G
FSF / D2D-PBI
Format
Partial Outcome
Outcome
NSF / ICC
Format
Hallucination
Outcome
BST / F2F / QCIC / TS / TSP / THHR / ETL
Format
Outcome
D2D-IR
Hallucination
Partial Outcome
Outcome
D2D-DD/HC/DS/RM
Lexical Outcome
Semantic Outcome
Reward Types
Group Compute
Advantages
A_1
A_2
…
A_G
EMR-LLM
Update