The case for remotely monitored objective measures in oncology*

	Data Science	Sensor/Hardware/ Infrastructure Community	Clinical community
Database generation, size, and expansion	Statistical analyses algorithms that identify data trends, which may sometime not be obvious by on-site evaluation Algorithms that combine data collected remotely with data collected in hospitals such as medically relevant information extracted from unstructured data such clinical notes	Unobtrusive/non-invasive data acquisitions	Minimal efforts on part of clinical community to include and combine structured data such as longitudinal health history (patient health credentials, such as age/sex, prior health complications, prescriptions etc.), hospital visit details, prescribed treatments/tests, and data generated by different clinicians/lab support personnel
Routine review of data quality	Total number of patients monitored, their health outcomes, mortality rates, relapse/readmission rates Evaluate data quality, missing/incomplete data, and data outliers Source data verification	Device strategies to rectify data issues that arise due to sensors/hardware	Infer odd behaviors: for instance, opioid over-prescriptions that could become a problem in future
Real-time data analytics	Ability to accomplish summative evaluation of health conditions Statistical analyses and algorithms that identify data trends, which may sometime not be obvious by on-site evaluation Accurate predictive models and unbiased evaluation of model accuracy that help decrease readmission/relapse rates	Seamless upgrade of technology/sensors with an ability to include additional sensors as per real-time analytics requirements	Event based programming paradigm that allows clinical inference-based triggers Long term longitudinal studies (large number of participants and long period of time)
Automatic alerts generation and communication system	Real-time communications of monitoring results Defining risk indicators that set off triggers and alert/trigger algorithms to support real-time monitoring: The advanced symptom generation system that generates alerts based upon a combination of health outputs and their threshold values A communication system that can facilitate communications in clinicians-to-clinicians, clinicians-to-health providers, and clinicians-to-patient, and patient-to-clinicians	Device system that supports real-time communications	Data triage strategies for clinical inference-based triggers that facilitate interventions such as provider- and/or protocol-directed interventions
Standardization needs	Interoperability of data Inter- and intra- vendor standardization Centralized monitoring center: Evaluate system robustness in "real-time" and address/rectify device related issues/failures	Device and data platforms standardization: Standardized data acquisition/user interfaces/monitors/sensors that generate consistent data such as electronic health records (EHR) Strategies to develop/advance technologies based upon: i) data integration ii) next-generation technologies/sensors iii) integrate new infrastructures, participants, and participatory centers/hospitals	Clinical practice guidelines (CPGs) are followed: standardized clinical care protocols that integrate standardized/approved practices with up-to-date knowledge
Implementation needs	Privacy and data security: Data is protected and privacy disclosure model is in place. Informed consent delivery End-to-end encryption Be able to evaluate protocol deviations and establishing compliance Monitoring clinicians and healthcare providers to protect human subjects No cherry picking of results, both successful and failed results/studies should be reported Criteria that will define frequency, timing, and inputs of data collections Implementation strategies with a goal to decrease relapse and re-hospitalization Be able to evaluate protocol deviations and establishing compliance	Proprietary platforms are hard to compare, issues with data interoperability, overall usability/clinical validity of the devices, and unification of data Lack of transparency and standardization among different commercial vendors might be an issue Regulatory aspects for sensor/technology/device implementation	Training of healthcare professionals, who implement these devices and evaluate the clinical efficacy/validation of devices Need awareness and training to incorporate remote monitoring in existing traditional workflows Need of clinically verified autonomous health system that can generate feedback-based interventions
Complexity of system	The data system complexity shouldn't hinder device usage	The sensor/hardware complexity shouldn't be obtrusive while supporting real-time data acquisition with minimal lag time	The system complexity should be at minimal to facilitate adoption by clinicians
Cost of system	A ubiquitous predictive healthcare model will be costly	Incentivize adoption of non-traditional methods such as remote monitoring	Medical liability insurances for remote monitoring need to be applied throughout the hospital care and public policies that advance remote monitoring

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