Based on advances in our understanding of genetics and pathophysiology, we are in the midst of an exciting therapeutic development period in rare diseases. The Orphan Drug Act defines as rare conditions those affecting <200,000 individuals in the United States. Examples of rare diseases include cystic fibrosis, hemophilia, spinal muscular atrophy, and most lysosomal storage diseases. Collectively, rare diseases are common, affecting almost 30 million individuals in the United States. Unfortunately, patients with rare diseases experience barriers to comprehensive care, and 95% of rare diseases lack US Food And Drug Administration (FDA)-approved disease-specific treatments. Key barriers to the delivery of high-quality care and therapeutic innovation include lack of access to disease experts, limited knowledge of disease course, and few partnerships between disease stakeholders. We propose a new health care model for patients with rare diseases, called the Care Continuum Model, which focuses on 3 concepts: (1) telehealth; (2) integration of care and research; and (3) improving patient–clinician–researcher collaboration.

Traditional health care involves local delivery of care. This model does not meet the needs of patients with rare diseases. These disorders often require multidisciplinary expert care, and individually affect small numbers of individuals dispersed over wide geographic areas. Consequently, diagnosis is delayed, and distance and disability limit access to ongoing care.

The Orphan Drug Act stimulated therapeutic development for rare diseases through provision of incentives, including tax credits, 7-year market exclusivity, protocol assistance, and grant support. The positive impact of the Orphan Drug Act creates even greater urgency for expert, accessible care. Many new therapies necessitate treatment in or monitoring by specialized centers. Because new biological therapies target diseases earlier in their course, timely diagnosis is increasingly important. This approach requires experience with a variety of presentations and thorough understanding of complex genetic testing options.

The Care Continuum: An Evolving Model for Care and Research in Rare Diseases

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THE CARE CONTINUUM MODEL

Modern technologies enable a new care and research paradigm for patients with rare diseases. This model leverages telehealth to eliminate geographic barriers to expert care, enables comprehensive data collection and improved understanding of natural history, and fosters improved patient–provider–researcher collaboration (Table 1).

In European countries, some networks enable patients to see disease-specific experts anywhere in the country. The immense size of the United States precludes expanding this approach through conventional in-person office encounters. In many ways, telehealth (ie, the provision of health care remotely) is ideally suited for individuals with rare conditions, and it directly addresses challenges of geography, travel burden, and access to experts. Financial, legal, and social barriers have prevented the realization of increasingly feasible telehealth models. Most states now mandate that Medicaid (n = 48) and private insurers (n = 29) provide telehealth coverage to the same extent that in-person care is covered, although coverage of home telehealth is variable. State licensing laws generally limit the care individuals receive to clinicians licensed in their state. Although an interstate compact has been proposed to facilitate licensure in 18 states, given its uncertain impact and the profound limitations of current laws, we propose implementing exceptions to current licensing laws for patients with rare diseases. This proposal would enable patients to receive care from any expert in the country.5

The Care Continuum Model would connect a greater proportion of individuals with rare diseases to expert clinicians, who are often also researchers. This strategy can meet the needs of patients seeking care and opportunities to participate in clinical trials; it can also meet the needs of researchers seeking to advance knowledge and therapies. We propose integrating care and research, leveraging video visits, remote monitoring, the electronic health record, and novel objective outcome measures, to form the basis for virtual longitudinal observational studies to characterize rare diseases. A classic example of the importance of clinical care data in research comes from experience in cystic fibrosis. The Cystic Fibrosis Foundation patient registry, used at expert accredited centers, has led to improved knowledge of the natural history of the disease and the development of clinical care guidelines that have resulted in dramatically improved outcomes.7,8 The integration approach could also lay the foundation for a pool of well-characterized individuals to participate in future clinical trials.

Our model encourages patient–clinician partnership that reflects the contributions of the patient as a disease expert. Patients with rare diseases often become as knowledgeable as or more so about their disease than their treating clinicians, and close patient collaboration is beneficial. However, this knowledge has yet to be fully harnessed for clinical care to more rapidly advance treatments and meet patient needs. Collaboration between the FDA and the Duchenne muscular dystrophy patient community resulted in detailed guidance to help sponsors in the development of new therapies, demonstrating the potential of such collaborations. The FDA is leading efforts to further engage patients in the drug development process: public meetings to learn more about rare diseases, efforts to improve understanding of patient tolerance for risk relative to potential therapeutic benefits, and welcoming patients at meetings with sponsors developing clinical programs. With the FDA, the National Organization for Rare Disorders has initiated several exemplar projects to harness patient knowledge and experience in a systematic manner, including development of longitudinal natural histories. Disease-specific organizations in conjunction with the FDA developed questions about each disease, and the National

### Table 1: Care Models for Rare Diseases

<table>
<thead>
<tr>
<th>Variable</th>
<th>Traditional Care Models</th>
<th>Care Continuum Model</th>
<th>Requirements for Model Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Who (relationships)</td>
<td>Clinician is the disease expert</td>
<td>Patients and clinicians are disease experts in true partnership</td>
<td>Culture shift, demonstration of patient engagement value</td>
</tr>
<tr>
<td>Where (location of care)</td>
<td>Driven by clinician location</td>
<td>Driven by patient location</td>
<td>Increased access to high fidelity, Internet access and HIPAA-compliant resources</td>
</tr>
<tr>
<td>When (timing of care)</td>
<td>Provider-centered timing</td>
<td>Patient-centered timing</td>
<td>Change in ability of clinicians to respond beyond standard office hours, across time zones</td>
</tr>
<tr>
<td>What (encounter content)</td>
<td>Clinical care completely distinct from research</td>
<td>Seamless integration of clinical care and research</td>
<td>New guidance(s) surrounding patient consent</td>
</tr>
<tr>
<td>How (reimbursement and licensure)</td>
<td>Care limited to clinicians in a given state</td>
<td>Care is enabled from any expert in the country</td>
<td>Expanded reimbursement and new licensure models that enable rare disease care</td>
</tr>
</tbody>
</table>

HIPAA, Health Insurance Portability and Accountability Act.
Organization for Rare Disorders built data capture and reporting software for use in longitudinal patient organization–driven studies. These and other models that engage patients as partners and experts can accelerate advances for many rare disorders in both care and research. Creating a mechanism for the development of patient–clinician–researcher relationships, which may not otherwise occur due to geographic limitations, facilitates an enhanced patient voice regarding establishment of clinical care priorities and a clinical research agenda that directly affects care.

CONCLUSIONS

The Care Continuum Model changes the time, place, and context of clinical encounters, addressing barriers to high-quality care for patients with rare diseases. Sweeping changes in the paradigm for delivery of care, reimbursement, and licensure will be required to enact this model fully. However, we anticipate high return on investment through expanded access to care, improved patient outcomes, reduced patient-incurred costs, improved understanding of natural history, and, ultimately, enhanced development of novel therapeutics. Our proposed model provides a new care model that delivers high-quality care for patients with rare diseases in both care and research. Although there is optimism regarding many therapies in development, avoidance of therapeutic misconception is critical. Frequent integration of care and research in pediatric oncology suggests that these challenges can be addressed. Similarly, lessons from expanded access programs, in which seriously ill patients are allowed therapeutic access to investigational drugs before marketing approval, have the potential to provide guidance.

In 1983, the Orphan Drug Act spurred development of much-needed therapies for rare conditions. Today, we need a new care model that delivers on the promise of these emerging therapies and the hope and needs of those affected by rare diseases.

ABBREVIATION

FDA: US Food and Drug Administration

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