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Structuring the Collaboration of Science and Service in Pursuit of a Shared Vision

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Structuring the Collaboration of Science and Service in Pursuit of a Shared Vision

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The enduring needs of our society highlight the importance of a shared vision to improve human functioning and yield better lives for families and communities. Science offers a powerful strategy for managing the inevitable uncertainty in pursuit of these goals. This article presents ideas and examples of methods that could preserve the strengths of the two major paradigms in children's mental health, evidence-based treatments and individualized care models, but that also have the potential to extend their applicability and impact. As exemplified in some of the articles throughout this issue, new models to connect science and service will likely emerge from novel consideration of better ways to structure and inform collaboration within mental health systems. We contend that the future models for effective systems will involve increased attention to (a) client and provider developmental pathways, (b) explicit frameworks for coordinating people and the knowledge and other resources they use, and (c) a balance of evidence-based planning and informed adaptation. We encourage the diverse community of scientists, providers, and administrators in our field to come together to enhance our collective wisdom through consideration of and reflection on these concepts and their illustrations.

The evidence-based practice initiatives of recent decades have moved our field beyond the question of whether science has a place in service systems (e.g., American Academy of Pediatrics, 2010; Hogan, 2003; Institute of Medicine, 2001; National Institute of Mental Health, 2008; Substance Abuse and Mental Health Services Administration, 2013). As Stuart and Lilienfeld (2007) eloquently stated, the debate is now about how evidence should inform clinical practice, not whether it should. Currently, two dominant paradigms influence our service systems, namely, evidence-based treatment (EBT) models (e.g., Chambless & Hollon, 1998; Lonigan, Elbert, & Bennett-Johnson, 1998; Silverman & Hinshaw, 2008) and individualized care models (e.g., Burchard, Bruns, & Burchard, 2002; Stroul & Friedman, 1986). Although each paradigm offers a fundamentally different answer to the question of "how," both have created a proliferation of technologies and social processes for addressing the health of youth and families. Nevertheless, the public health impact of neither of these paradigms has been fully realized (Kazdin & Blase, 2011; Rotheram-Borus, Swendeman, & Chorpita, 2012).

To set a context for considering possible paradigmatic successors that might also preserve the strengths of the EBT and individualized care approaches, we briefly put aside the question of "how" and consider the question "why" and the issues it necessarily raises. It is important to consider our purpose in connecting science and service, because we contend that the application of science should explicitly be a strategy and not a goal unto itself.

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This distinction warrants particular consideration, given the emergence of policies in some research and service contexts that focus narrowly on dissemination and implementation of EBTs, which may well be an excellent strategy for meeting a goal, but not—in our view—a sufficient or suitable goal unto itself. As a strategy for pursuing a shared goal, the scientific approach is unmatched in its ability to help prioritize promising ideas over less promising or even harmful ones. Although science does not offer certainty in that pursuit, it is a way of reducing and managing the inevitable uncertainty. A key role of science is to help manage this uncertainty and to move systems and communities more efficiently toward their collective goals.

This application of science to goals necessarily occurs in a context of values. Whether explicit or not, various principles, rights, beliefs, cultures, and preferences are always in play when organizing a service system, but consistent with the sentiment of Stuart and Lilienfeld (2007), these values are often better served when operating in a world of facts (i.e., the principle of empirical epistemology; see Chorpita & Daleiden, 2010). Values-based propositions, which are claims based on a shared set of beliefs or preferences, must be distinguished from fact-based propositions, which are those claims that could be tested or falsified (e.g., Simon, 1947). One may believe as a matter of values that children should not experience impairing levels of anxiety when taking a routine math test, but it is a matter of fact that exposure-based treatments have a long experimental history of reducing such anxiety in children. Values commonly guide the goal setting and expectations in both research and practice contexts—whether by inspiring research questions or setting clinical benchmarks—and thus are at the heart of both statistical reasoning and regulatory control systems that involve comparisons of desired states (e.g., minimal test anxiety) to observed states (e.g., high test anxiety) as a way to guide decisions and actions (e.g., what to do about such a discrepancy). In answer to the question of "why," then, we offer the values-based assertion that the application of science in service systems should be in pursuit of the larger vision of stronger communities, healthier families, and better lives. This assertion then leads us to return to the question of "how." How does one best organize the facts as well as the systems that must make use of the facts in order to achieve this shared vision?

The current article introduces a set of ideas intended to speak directly to that question—explicitly considering the complex nature of service systems along with design strategies that lend themselves to handling such complexity. For the preceding articles in this issue, we invited contributors to illustrate many of these ideas and principles in action across a diversity of innovative projects or initiatives. By design, this collection was neither definitive nor comprehensive. Rather, it was intended to inspire new thinking and to emphasize the range of possibilities for better realizing the public health benefits of science. In this article, we seek to offer a unifying vision that puts these many illustrations into a potentially new paradigmatic context.

THE PROBLEM OF COMPLEX, DYNAMIC SYSTEM COORDINATION

Developmental Nature of Systems

To consider how best to make systems more effective and goal directed, it is important first to explicate the developmental complexity of the task at hand. The rising, darker-shaded arrows in Figure 1 illustrate that youths and families in mental health service systems are in a constant state of development. Over time, youths naturally experience changes in cognitive capacity, physical strength, behavior patterns, knowledge, and opportunity sets, some of which might be produced by therapy, others not. The figure illustrates a linear increasing path for simplicity, but it is well known that development is often characterized by peaks and valleys and can involve both enhancement and deterioration.

Mental health service providers (i.e., broadly defined as any agents, objects, or processes playing a therapeutic role in mental health systems) are in a state of development as well, as illustrated by the lighter shaded arrows in Figure 1. Therapists can gather experience and knowledge, achieve automaticity over common tasks and procedures, acquire new credentials, and enhance existing competencies. Therapeutic software or books (technically speaking, also providers) can be revised and updated based on newly accumulated findings. Although not illustrated explicitly in Figure 1,

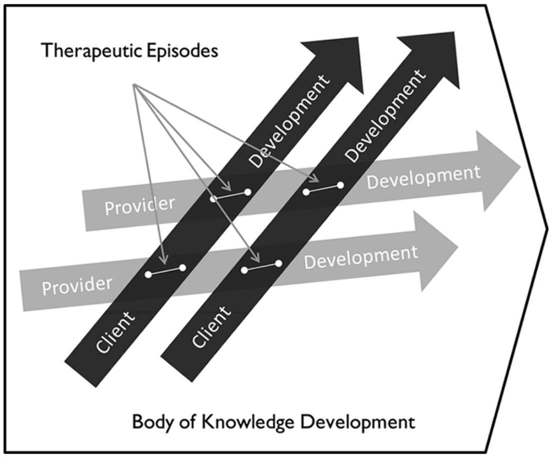

FIGURE 1 Intersecting pathways of client, provider, and knowledge development in children's mental health systems.

service providers operate in the context of organizations that are also changing and developing, which in turn often operate in larger developing systems of evolving policy, external requirements, and competition. Finally, these multiple, linked developmental pathways are always acting in an evolving body of knowledge and technological capability. The literature continues to grow, and evidence for new ideas and options continues to accumulate, so the context for these multiple intersecting individual and organizational trajectories is always changing in the background.

Recognizing the developmental nature of systems is important because building effective mental health systems requires influencing the therapeutic activity that occurs at the intersections of service providers and clients in the context of the current body of knowledge (see Figure 1). As the figure indicates, these entities will be in different states of development at any point in time. Given the principle that prior development constrains future development (cf. Sroufe, 1979), some clients or providers will be ready to take certain next steps, but others will not. This developmental heterogeneity therefore calls for flexible infrastructures that provide personalized interfaces to the current knowledge base to meet entities where they are and to spell out the pathways toward desired goals. Stated concretely, youths and families should be supported to engage in those therapeutic activities that best fit their current needs and build on their current strengths, given the current state of the evidence. Likewise, providers should engage in therapeutic activities that they are prepared to deliver well now but that may also help them further develop their skills for the future. And in the pursuit of collective goals, those activities should always be informed by the best available knowledge.

We raise the dynamic and developmental nature of systems not merely to emphasize complexity but because we see it as a fundamental challenge to the current paradigms. The two dominant paradigms, the EBT model and the individualized care model (e.g., Systems of Care, Comprehensive Planning, and Wraparound Service Models), offer few personalized interfaces to the scientific knowledge base. The EBT paradigm commonly takes the logical form of "clients with problem X receive treatment Y," and likewise, "to provide treatment Y, providers must go through training Z." Alternatively, individualized care approaches, which prioritize empowerment of clients, cultural sensitivity, use of least restrictive service environments, promoting family preservation and strength, coordinated service planning, use of natural supports, and youth and family rights (e.g., Stroul & Friedman, 1986), tend to emphasize social interfaces and group processes (e.g., requiring family membership on treatment teams) while having less clear or direct reliance on structured scientific knowledge (e.g., treatment protocols, research studies). Given that neither of the current paradigms explicitly offers a personalized interface with the body of scientific knowledge, we may benefit from fundamentally changing the way we organize and interact with facts and knowledge to enhance the therapeutic activities that occur at the various intersections represented in Figure 1.

The Design-Time/Run-Time Imbalance

Other disciplines have dealt with this specific type of dynamic complexity and have established conceptual frameworks that may help us to see the current problems of our own discipline more clearly. For example, in information science, a distinction is often made between features of an entity that are established or controlled during *design time* and features that are controlled during *run time*. Design-time control involves engineering an object or entity to have certain attributes and features in advance, before it is free to behave in a given environment. Run-time control, on the other hand, involves the manner in which an object or entity is further configured or affected by interacting with its environment. Early paradigms for writing computer code typically involved scripts or lists of commands that executed sequentially, representing a heavy design-time emphasis. Modern software, on the other hand, more commonly employs object-oriented approaches, which define object classes and assign them attributes—features that define how instances of those objects will behave—in design time. During run time, instances of those objects interact with other objects by passing messages that can guide what happens next by changing the receiving objects' properties. For example, when one clicks on a window on a personal computer and the window opens, the window is not simply following a procedural script; rather, one's action of a mouse click issues a message to the window requesting that it changes its "view" property from closed to open. The object behavior is therefore a function of its design-time composition (an attribute that dictates when clicked, change the view property) as well as what happens to it in the run-time environment (a mouse click). As the number of objects and complexity of the environment increase, action may appear increasingly less predictable and script-like but is instead guided or bounded by the objects' predefined attributes.

Analogous concepts frequently appear outside information science. For example, a football game has rules, playbooks, players, and a location configured or selected in design time, but the game unfolds with plenty of run-time control: Plays and strategies are continually updated in response to such things as field conditions, opponents' performance, player injuries, and time on the clock. Or consider an example from music: By following a carefully notated musical score, classical music often emphasizes design-time control, whereas jazz, which embraces improvisation, places more emphasis on run-time control.

Applications of science in service within the EBT paradigm manage uncertainty largely through an emphasis on design-time controls (e.g., What procedures should be in a treatment manual? What order should they follow?). However, in the operation of service systems, emergent events and local circumstances, including different points in developmental status alluded to in Figure 1, also have the potential to guide appropriate action and reduce uncertainty. For example, the activity of a provider following a treatment protocol presumably should change if a youth client is too upset to speak that day; one would not continue to administer a manualized treatment to an unwilling participant in that moment. Likewise, a provider might handle a family with many preexisting strengths and skills differently than a family with few strengths and skills. However, current approaches that heavily prioritize design-time control typically force the provider to (a) ignore such information (e.g., the provider persists with the protocol that was established in design time) or (b) enter an exception/error state and engage in spontaneous and potentially uniformed action (e.g., the provider takes a best guess about how to handle an unexpected event or how to accommodate baseline differences). In our own delivery of EBTs, we each have encountered circumstances in which we have engaged in one or the other of these less preferred responses (i.e., either ignoring exceptions or improvising when they emerge), largely due to the inadequate architecture of the guiding treatment protocols with respect to their balance of design-time and run-time control. It was not always appropriate to stay on script, but there was minimal structured guidance when we went off-script. Parallel issues arise with respect to provider training, given that some providers cannot take time away from service delivery to attend trainings, or at least to attend trainings of a particular duration. Common sources of interference include family issues, maternity leave, or changing employment to a new organization. When and whether any of these events represent true exceptions or “special cases” (Meehl, 1957) is of course its own question of considerable importance, which can and should be subject to empirical scrutiny. Either way, we currently have underdeveloped resources both for identifying exceptions and for informing subsequent action when they truly arise.

Examples emphasizing design-time control are common within the EBT paradigm and include (a) treatment manuals that specify that all clients receive the same structured treatment regardless of their baseline status or emergent events, and (b) training and certification programs that assume a uniform baseline for all providers seeking to learn a new treatment (i.e., even expert providers must start with Lesson 1) or that require a single curricular pathway to achieve a professional development goal (e.g., a 2-day workshop is mandatory for certification). Because of the EBT paradigm’s significant emphasis on building protocols and procedures in design time, there are currently few examples of EBTs that explicitly support incremental or adaptive therapeutic activity for clients or incremental or adaptive training for providers.

Apparent exceptions to this problem frequently fall into one of two categories. First, some EBT programs (e.g., Triple P; Sanders & Markie-Dadds, 1996) formally accommodate baseline differences, for example, by offering multiple intervention levels to match different levels of need or different histories; however, such solutions often do not support formal run-time control within each level, and thus merely establish multiple versions of the protocol, each of which corresponds to further subdivisions of the population anticipated at design time. Moreover, even EBT programs that offer multiple versions for different baseline conditions (e.g., a prevention series for at-risk families, a high-intensity series for families with significant challenges) typically do not acknowledge client or provider history that has occurred outside the overarching program (e.g., giving credit to a family or provider who has learned and mastered a time out procedure from a different brand of EBT program). In other words, even in the best of circumstances, the developmentally individualized interface is not an interface with the larger scientific knowledge base—it is only an interface with a specific EBT program that resides within that larger knowledge base.

Second, although both flexibility and reflection have been given consideration within the EBT paradigm (e.g., Kendall, Gosch, Furr, & Sood, 2008), adaptation in such illustrations is primarily developed spontaneously or intuitively by the provider or treatment team and is not informed by a structured source. In other words, treatment manuals typically do not give explicit guidance for when and how to skip an activity within a session, skip an entire session, repeat a session, or introduce content from a different EBT. There is often a trade-off of adaptation against structured, informed guidance, such that flexibility can rapidly increase uncertainty.

Nowhere is this trade-off more apparent than within the individualized care paradigm, which, in stark contrast to the EBT paradigm, heavily emphasizes run-time control. Plans of care are individualized and family centered but often at the expense of using structured scientific sources such as EBT treatment manuals, which have long been considered incompatible with highly individualized care (Addis & Krasnow, 2000). For example, an individualized service plan might call for a youth to learn a subset of skills that may be part of an EBT program (e.g., how to be assertive with peers), but there are no guidelines for how a provider can selectively apply only parts of that EBT or for how that provider could be trained in only those parts. Individualized care, then, typically proceeds without making full use of the best available research (in this case, using a structured procedure for teaching and rehearsing assertive interactions). The design-time/run-time distinction shows us that both clients and providers are typically caught between these two paradigms: one that prioritizes design-time activity, resulting in limited opportunities for informed adaptation, and one that prioritizes run-time activity, resulting in adaptation that often fails to leverage the larger body of knowledge.

Coordination in Complex Systems

Given the dynamic nature of the systems involved, we turn to the broader problem of how best to manage not just treatment and training program design but all elements and members of the system, and perhaps we now do so with a greater appreciation of that question's complexity. Clients, providers, and organizations at different developmental stages are involved in continual development (e.g., therapeutic, professional), and meanwhile, the relevant knowledge and resources continue to evolve around them. Thus, we are badly in need of an organizing architecture—a set of principles for how the relevant parties should interact and make use of the knowledge base in the service of their respective goals. This problem concerns more than the individual parts: It is not sufficient only to have effective treatments, engaged clients, or knowledgeable providers—we must also consider how these entities work together in a system.

Malone and Crowston (1994) offer a useful framework in this regard, one that can help to spell out desired elements and principles of an organizing architecture for systems. Malone and Crowston define *coordination* as the management of dependencies among activities and resources. Activities are the actions in which individuals or entities engage. In the mental health system context, activities can include therapy sessions, training events, credentialing, billing, hospitalizations, assessments, utilization review, report writing, audits, among many other things. Resources, on the other hand, are assets put to use in the service of these activities. In mental health systems, resources include such things as people, time, funding, space, and knowledge.

Coordinating simple activity-resource dependencies, such as scheduling a meeting with one other person, typically demands minimal explicit attention to coordination infrastructure and is something most of us do without difficulty. However, a more challenging coordination task, such as scheduling a service planning meeting with a student, a parent, a provider, and a teacher, and for which there must be multiple copies of completed assessment material available for review, may benefit from an explicit, defined process model that spells out the logic and steps of whom to contact when, in what order, and how to handle participant responses or lack of responses. There are in fact some good examples of coordination algorithms designed to serve some of the more common complex coordination tasks in mental health service delivery, such as the identification, triage, and treatment for youths with ADHD (American Academy of Pediatrics, 2011). As the complexity of a coordination task escalates (e.g., involving a greater number resources or a higher degree of dependencies), the need for an explicit framework and well-defined processes typically increases. At present, mental health systems often face the most complex coordination tasks with few or no such structured supports (e.g., the task of arranging a service array that provides EBT options to all youth and families, minimizes service waitlists, and makes optimal use of the provider workforce). Given that these complex coordination demands arise within the dynamic systems just noted (developing clients, providers, and organizations, amidst an evolving body of knowledge), there is an urgent need for a developmentally sensitive, scientifically grounded, coherent, and explicit coordination framework, which is currently not offered by either of the dominant mental health service paradigms.

TOWARD SOLUTIONS

Ideally, mental health service systems should coordinate activities and resources to support intelligent, goal-directed action among participants and to realize the opportunities for all parts of the system to develop further (e.g., clients, providers, organizations, the knowledge base). Although it is not possible to articulate a single definitive solution to the problems just noted, we feel that the rudimentary features of potential solutions are as follows: to improve service system performance, our discipline will need to (a) outline explicit models for coordination of activities and resources, (b) balance design-time and run-time control in a manner better suited to the individualized and developmental nature of both the mental health concerns of clients and the professional development activities of providers, and (c) facilitate goal-directed decision making and action supported by developmentally individualized interfaces with the relevant knowledge bases for both clients and providers.

Coordination as an Explicit Feature in Systems

As previously detailed, coordination is a structured approach to defining how resources and activities work together within a system. Improved performance can come from more careful coordination of the existing set of resources and activities, much as a sports team can improve without adding new players, simply by addressing teamwork. Thus, coordination is about improving performance with the same workforce and the same knowledge base, aligning neatly with the adage of "working smarter, not harder."

Some aspects of mental health system performance already have well-defined coordination models, like the ADHD guidelines previously mentioned and like the development of a "plan of care" within the Wraparound Service Model. However, examples of the absence of coordination abound in mental health systems: We currently have few formal models to determine when providers will learn new treatments, how sustained learning will be managed in the face of workforce turnover, how many treatments a provider must (or can) master to serve his or her caseload, where the services can be accessed, whether funding strategies are compatible with service programs, and whether service programs are compatible with each other, just to name a few examples. Thus, it is necessary to examine resource-activity dependencies in systems and provide new models for them to work together. These models should spell out not just information resources such as treatment manuals, but workforce roles, treatment settings, funding sources, and access points, among many other things. Further, system design will need to outline how these different aspects of the system will work together in concert, by outlining common business practices that coordinate multiple people, treatments, or other resources with specific goals in mind (e.g., treatment planning meeting, service quality reviews).

Achieving Design-Time/Run-Time Balance

Given the complex and dynamic nature of the work in our discipline, service and training architectures should explicitly consider the balance of design-time and run-time control in order to accommodate differences in current status and to manage exceptional events. Handling both issues is not a new concept in other areas of our lives. Navigation in automobiles using GPS technology works on a platform of design-time controls (i.e., satellites, stored maps, compact displays, etc.) but also depends on run-time controls to develop the initial route based on a driver's current position (i.e., accommodating differences in current status) as well as unlimited updates to the route to handle detours, surprises, or driver errors (i.e., managing exceptional events). In much of our work in mental health service systems, we are still driving with paper maps. Perhaps more troubling, we spend much of our current research efforts attempting to build better paper maps, whether it be treatment programs or training models.

How do we move from maps to GPS? Ironically, allowing for run-time control must be dealt with in design time. This means that treatments or business procedures need to be developed in advance to account for differences in current status and exceptional events, with structured guidelines for how to handle each. For example, we have in the past proposed that modular design of therapeutic interventions is a structural feature that lends itself to run-time control (Chorpita, Daleiden, & Weisz, 2005). Among other things, modular design eliminates certain dependencies in a treatment or curricular architecture, thus allowing a greater variety of arrangements while keeping essential features intact. For example, in some treatments, Procedure A must precede and must be followed only by Procedure B, because the material outlined in Procedure B makes explicit reference to Procedure A (e.g., Procedure B opens by asking the provider to review client progress on Procedure A). Modular design considers whether these dependencies are necessary—if A is truly inseparable from B, then they must be contained within the same module, or else module A must be enforced as a prerequisite to B (i.e., rule: A need not be followed by B, but B must always be preceded by A); otherwise, cross-references should be removed so as to allow them to be delivered in either order. Modular design also allows for focal updates to protocols and procedures as the research evolves, thus providing a potentially more efficient interface with the current body of knowledge. For example, if a time out procedure is experimentally shown to have greater effects when the parent is responsible for terminating the time out interval versus when the child is responsible (Bean & Roberts, 1981), a properly encapsulated time out module could be updated within any protocol that uses a time out procedure without rewriting, retesting, or retraining the entire protocol.

The same concepts apply to the design of training curricula. Some are necessarily cumulative, and others are not, but the training content can be outlined and coordinated. Explicit parsing of a training program into independent modules can allow customized pathways for individuals to update their expertise based on current needs and learning history (i.e., differences in current status) as well as performance errors, training absences, or early failure to meet evaluation standards (i.e., exceptional events).

Freeing up the dependencies among the subunits of any resources, whether treatment protocols or training curricula, allows the provider or trainer to customize, adapt, or update as needed, without worrying about logical errors or wasted time that might be introduced. Modular design offers a coordination framework that spells out the possible, impossible, and preferred arrangements of content based on the goals a treatment or curriculum is designed to achieve as well as the demands that it is likely to encounter.

Knowledge Management and Informed Action

To operate effectively, whether using strategies developed in design time or run time, one must be able to prioritize and select among possible actions and then perform one of them in an attempt to reduce uncertainty about goal attainment. Whether selecting a treatment manual, performing a specific clinical procedure, or developing a treatment plan, one's decisions and actions are presumably informed or guided by knowledge. Most definitions generally describe knowledge as information that is useful to decision making and that predisposes action (see Rowley, 2007); thus, it is inherently embedded in decision and action models. The enterprise of organizing and delivering knowledge to serve decisions and action is at the heart of the discipline of knowledge management. It follows that improved knowledge management may facilitate more promising decisions and actions in pursuit of selected goals.

Opportunities to evaluate our discipline's current knowledge management approaches are ubiquitous. Treatment manuals are a knowledge management strategy to guide the performance of clinical practice. EBT registries are a knowledge management strategy to guide the selection of promising treatment options. Assembling a team that includes teachers, clinicians, and family members is a knowledge management strategy to guide the development of a personally relevant treatment plan, such as one might find in an Individualized Education Program. Knowledge management is already implicit in much of the work that goes on in both science and service. Considering knowledge management explicitly, however, can expose opportunities for increasing the quality, availability, and utility of knowledge, which is discussed in greater detail next, after we first consider two central aspects of knowledge infrastructure—ontologies and messaging.

Ontologies. As described previously, knowledge must by definition have meaning that can guide decisions and action. That meaning is supported by onotologies, which are construct systems within a domain that specify the terms and their interrelations and thus provide the vocabulary for that domain (Gruber, 1995). Several formal ontologies relevant to mental health systems have been developing, such as the American Psychological Association's Thesaurus of Psychological Terms, and the U.S. National Library of Medicine's Medical Subject Headings, and Unified Medical Language System. Formal ontologies may offer several benefits for coordinating science and service. First, they may structure the nature of messages, promote consistency, and facilitate the transmission of knowledge (e.g., shared meaning of such terms as "cognitive behavior therapy" (CBT) or "child maltreatment"). Second, they support the application of formal reasoning, including automated reasoning (e.g., meta-analysis), that may help develop new knowledge, activate new ideas, and elucidate errors or exceptions in existing models. Third, ontologies may play a cultural role by shaping language, for example, through the inclusion and exclusion of acceptable and unacceptable terms.

A provider may act based on knowledge from science, and likewise, a scientist may develop hypotheses based on knowledge from service. This kind of exchange—fundamental to knowledge management—is greatly facilitated by at least a partial alignment of ontologies across science and service (e.g., Is a client's "withdrawal" the same as a published study's "major depression"? If so, the study is relevant and could guide choices relevant to the client's care). Although science and service systems clearly have independent ontological requirements given their different immediate aims, there is considerable value in developing common language or at least mechanisms by which to establish shared meaning (within and across systems) regarding constructs within the domains of primary interest.

What are some of those domains? Table 1 illustrates some possibilities, by no means definitively, which are laid out in terms of the client, provider, and organizational developmental pathways just described. Some ontological systems are already quite extensive. For example, one dominant paradigm in both science and service relies heavily on the *Diagnostic and Statistical Manual of Mental Disorders* as a mature ontology referencing targets (i.e., What diagnosis should be addressed?) and outcomes (i.e., Did the diagnosis remit?). Likewise, over the past 20 years, EBTs have become a dominant ontology of practices. Other cells in the table refer to constructs and domains that are comparatively less developed, such as those related to provider practices, organizational targets, or coordination. This is not to say these domains of the ontology are empty; a handful of treatment packages include some features of a coordination ontology. Multisystemic Therapy and the Wraparound Service Model, for example, adopt explicit structures and activity sequences for coordinating care (e.g., supervision, consultation, team planning). But such instances are less common and are often contained within the specific programs or service models, each limiting their ontological utility to that program's context.

Although ontologies are clearly of value, they are not all equal. Certain ontological structures lend themselves better to certain types of decisions and actions. For example, some of our earlier published work has sought to identify practice elements common to EBTs (e.g., Chorpita & Daleiden, 2009), often referred to as the "common elements framework." This work contributes a complementary level of analysis within the practice

TABLE 1
Examples of Ontological Content Relevant to Client, Provider, and Organizational Development in Mental Health Systems

	Examples		
Domain	*Client Development*	*Provider Development*	*Organizational Development*
Targets/Outcomes	Diagnostic and statistical manual diagnoses Scores on defined measures Research domain criteria Individualized Education Plan goals	Interpersonal competencies Therapeutic effectiveness Certifications	Cost-effectiveness Climate and culture
Practices	Evidence-based treatments Common elements of treatments	Clinical supervision Training workshops Continuing education Common elements of supervision	Leadership training Strategic planning
Populations	Children Adolescents Families Race/ethnicity Language spoken	Providers Supervisors Support workers Teachers Nurses	Publicly funded community clinics Directly operated government programs Schools Managed care organizations
Contexts	Urban/rural School/clinic/home Poverty Stable/unstable community	Solo practice Community mental health Child welfare Juvenile justice	Recession/economic growth Privatized vs. socialized health care
Coordination	Assessment precedes treatment	Supervised work precedes licensure	Accreditation must occur every 3 years to continue operation

dimension of the ontology (see Table 1), but one that was intended to increase decision-making opportunities by allowing a different set of conceptual units that define practice. For example, one could develop a new treatment by analyzing the practice elements common to a given target, population, and context (a design-time endeavor). One could also adapt an existing treatment by introducing a specific practice chosen to address an emergent and focal issue (a run-time endeavor). As another example, the recent emphasis on Research Domain Criteria (National Institute of Mental Health, 2008) is intended to establish an ontology of targets based on dimensions of observable behavior and neurological indicators, to which focal treatments might ultimately be mapped—which represents an alternative to a purely diagnostic ontology of targets. These diverse ontologies obviously have different implications for how they will influence decision and action—for researchers and providers. Ontological structure should therefore take into account the knowledge management demands in the systems that the ontology is ultimately intended to support.

Messaging. A second important aspect of knowledge infrastructure is messaging, which involves passing data, information, or knowledge from a sending process to a receiving process (Message Passing Interface Forum, 2012). By definition, information becomes knowledge when it can influence or guide decisions and action. Thus, it must be present in the context of that decision or action, and messaging is the mechanism by which the information travels into that context.

Some promising examples of messaging have already emerged within our discipline. Messaging can deliver feedback to promote self-correction (e.g., measurement feedback systems; Bickman, 2008; Chorpita, Bernstein, Daleiden, & the Research Network on Youth Mental Health, 2008; Lambert, Harmon, Slade, Whipple, & Hawkins, 2005), can deliver cues to increase the likelihood that certain clinical events occur (e.g., telephone reminders for appointments; Watt, Hoyland, Best, & Dadds, 2007), or can prompt providers to perform a practice in a structured manner (e.g., checklists/guides to promote integrity of service delivery). However, the processes and various mechanisms for messaging, both social (e.g., putting family members in a treatment team meeting) and semantic (e.g., putting the *Diagnostic and Statistical Manual of Mental Disorders* on one's desk), merit more explicit elucidation and systematic construction. For example, clients and providers at different points in development may need to receive messages in different ways (e.g., to perform a given practice with integrity, the expert provider uses a brief checklist, whereas the beginner follows a detailed script). Further, our current messaging strategies may have vulnerabilities for delivering knowledge to the right place at the right time. For example, a treatment manual or a set of written guidelines is an effective strategy only if referenced or remembered at the time of decision making. The use of antecedent, "feed forward" strategies (e.g., cue, triggers, or reminders) to "bias" responding based on evidence may be an enhanced messaging strategy to deliver the same knowledge. More generally, considering messages separately from the knowledge contained within those messages may lead to overall improvements in knowledge management.

Knowledge resources. Graham et al. (2006) outlined a multiphase model of knowledge management that is useful in this context. They described Phase I as "the unmanageable multitude of primary studies or information of variable quality that is out there and that may or may not be easily accessed" (Graham et al., 2006, p. 18). Typical examples include primary source experimental research findings that are relevant to treatment outcome or professional training issues. Phase II is characterized by consolidation, which involves organizing information from the prior phase to give it context and meaning. Examples of Phase II resources in the practices domain include national and international consolidated reviews, such as those by the Cochrane collaborative or the National Registry of Effective Practices and Programs (Substance Abuse and Mental Health Services Administration, 2013). Finally, Phase III takes into account the process of integrative reasoning from the consolidated, Phase II resources (e.g., as when making a specific decision using a list of EBTs). Graham et al. referred to this phase in the cycle as yielding knowledge tools or products, which should "provide explicit recommendations with the intent of influencing what stakeholders do" (p. 19).

We refer to these tools or products as "knowledge resources," that is, knowledge delivered using a defined messaging strategy. For example, the treatment manual format is a messaging strategy, but each specific treatment manual is a knowledge resource, because each contains a representation of knowledge (i.e., a guide for provider behavior informed by a research study) within a specific messaging strategy (i.e., a manual). Likewise, a clinical dashboard or measurement feedback system is a messaging strategy, but when it illustrates benchmarks for outcomes, indications of preferred practices, or client scores, it becomes a knowledge resource.

We should understand from all of this that in the absence of a knowledge resource, it is unlikely (or less likely) that the appropriate knowledge will inform a given decision at any given moment. By definition, Phase I sources do not involve an efficient messaging strategy tied to a particular decision model. They are therefore difficult to use—for example, few providers would be expected to mentally recall and aggregate all of the relevant studies underlying a particular clinical decision in pursuit of a defined clinical goal. Even Phase II sources can be cumbersome: when lists of EBTs point to multiple options for the same populations, there is little systematic guidance if one needs to select just one as a best option for a given client—the lists merely provide contextualized information, but they do not say which option is best. Ultimately, decisions that inform potentially goal-relevant action in a system should be supported by knowledge resources that are more precisely keyed to those decisions.

Knowledge resources are especially important in activities involving run-time control, because such control involves more decision making in the moment. Just as a GPS navigation device operates best with updates regarding the driver's current position as well as current road closures or traffic patterns, run-time control in mental health systems may be fruitfully guided by such information as a provider's training status or a client's clinical status, benchmarks or goals, current status of the treatment knowledge base, and current obstacles to progress.

Multisourcing decisions. Thinking explicitly about knowledge resources opens the possibility of having multiple resources and even multiple knowledge bases behind a single decision or action. In our earlier work, we have sketched a model that outlines four separate knowledge bases (Daleiden & Chorpita, 2005). Figure 2 shows an example and further organizes these knowledge bases into *general knowledge* (i.e., typically generated outside of the current context and thought to generalize to many contexts) and *local knowledge* (i.e., typically generated within a specific context highly relevant to or the same as the current one). At the service system level of analysis, examples of general knowledge include treatment-outcome research, which tests defined procedures in a given context using an established ontology (e.g., CBT for anxiety in 10-year-olds), as well as clinical theory, which includes both experimental research and expert consensus (cf. American Psychological Association Task Force on Psychological Intervention Guidelines, 1995). For example, the notion

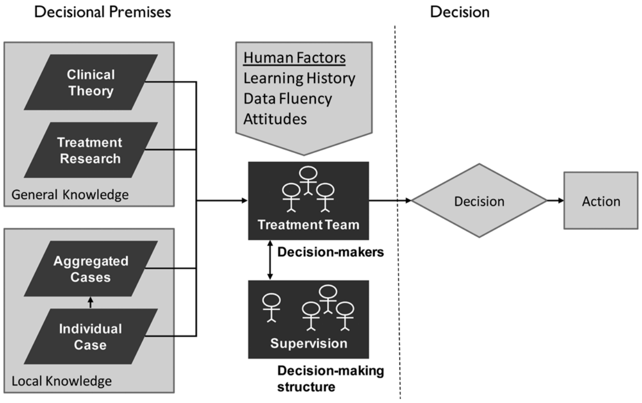

FIGURE 2 A general framework coordinating multiple knowledge bases and system members to inform decision and action.

that rewards contingent on a given behavior increase the probability of future occurrences of that behavior represents knowledge drawn from clinical theory.

Local knowledge, on the other hand, comes from the local context and can involve individuals (e.g., a current clinical diagnosis, or a history of clinical progress as measured in multiple observations over time, etc.) or groups (e.g., the rate of elopements at a particular residential facility, or the average effect size for a defined treatment approach in a particular county, etc.). Typically, but not always, there is a trade-off among these various sources of knowledge, with local sources being more relevant but general sources being more reliable due to experimental controls.

In the EBT paradigm, a specific manual being used is a knowledge resource that serves to guide the decisions and actions of the provider. In other words, the activity that occurs in a therapy session follows a set of codified procedures previously defined and tested in one or more experimental demonstrations selected from the larger knowledge base (i.e., treatment outcome research; Figure 2). To the extent that Phase III knowledge resources do not exist for other knowledge bases, for example, referencing individual case knowledge or clinical theory, the sole knowledge resource available will be heavily prioritized. In this case, the provider must rely almost exclusively on the manual.

In many cases, this reliance will be fine. However, in our discussion of run-time control above, we highlighted the need potentially to accommodate differences in current status or to manage exceptions should they arise. For example, a child might respond poorly to a given treatment that is being used. A knowledge resource that provides outcome feedback (i.e., individual case knowledge; Figure 2) accelerates the detection of the poor response, and a knowledge resource that suggests and details other relevant treatment options (i.e., treatment outcome knowledge; Figure 2) provides ideas and instructions for informed adaptation. Similarly, a particular treatment that works in general may have limited success in a given neighborhood context or local setting, which could be inferred from a report summarizing local outcomes for a specific treatment (i.e., aggregated cases; Figure 2). Ideas for adaptation could be inferred from local knowledge regarding other treatment approaches that have or have not worked well in that context.

Properly designed knowledge resources could message clinical theory as well. For example, a great many EBTs exist for childhood anxiety, most of which involve exposure-based procedures originally developed decades ago. Emerging experimental research and clinical theory, however, are beginning to outline methods for increasing the potency of exposure itself, through such means as manipulating the exposure context or presenting compound stimuli (e.g., Culver, Vervliet, & Craske, 2013). In some circumstances, we think it is justified to consider adapting the delivery of a manualized treatment to incorporate these latest theoretical developments. But there are currently no structured knowledge resources representing clinical theory (see Figure 2) to guide that adaptation. These resources can of course be developed and would require explicit methods for defining, coordinating, and messaging this type of knowledge.

Collaborative Design

Ultimately, we need a framework that pulls together the relevant knowledge and the relevant members of a system and organizes them around common, critical decisions. Ideally, such a framework would balance both design-time and run-time control by including design-time knowledge resources such as treatment manuals (or codified guides that link to other concepts within the practice dimension of the ontology, such as practice elements) along with clinical theory, local aggregated case knowledge, and individual case knowledge about the client. Ideally, all of these four knowledge bases would each be associated with specific knowledge resources that could provide clear developmentally and contextually sensitive messages to the decision makers, whose roles are also specified in the model. We refer to this process as "collaborative design" because it spells out multiple decision-making entities and allows them to contribute mutually to the decision and action at hand. Collaborative design is about creating a context that supports informed and goal-directed action among members of a system.

Who designs? An ideal collaborative design infrastructure should allow all relevant members in the system to participate in the collaboration. In the context of EBTs, treatment manuals are codified by a treatment developer in design time, often an investigator scientist in the laboratory. To the extent that a provider follows the manual, the activity—the therapy—guided by these manuals is largely investigator designed. The provider and family contribute relatively less to the design of the therapy activity. At the other extreme, therapy that occurs in the context of other practice models, including individualized care models, is often designed in run time—week by week, and even moment by moment—by the provider, youth, and family. Such treatment activity might be largely designed by the treatment team (inclusive of the family), with the scientist excluded from the participation. Ideally, a collaborative design infrastructure should allow the scientist to participate by contributing well-established knowledge resources developed in design time, and the treatment team to participate by acting on differences in current status and exceptional events that arise in run time.

The purpose of this collaboration is not to have everyone contribute equally or simply to have all perspectives considered; rather, each participant in the collaboration contributes according to the strengths that are associated with his or her role. The scientist is typically in the best position to understand general knowledge regarding treatment-outcome relationships in defined contexts but typically in the worst position to anticipate emergent exceptional events. The opposite is true for the treatment team—hence the need for collaboration in design.

How to design? Following this point, we believe our earlier discussion of knowledge management highlights that reliance on mental representations of knowledge by the various members of the collaboration is insufficient. Collaboration should put the relevant knowledge from multiple knowledge bases (as shown in Figure 2) at the metaphorical fingertips of the decision makers and actors. Knowledge needs to be delivered through messaging strategies that are optimized for the behaviors in context (e.g., a refrigerator magnet reminding a caregiver to praise might extend the effectiveness of a handout reviewed in a therapy session) and that are sensitive to differences in client status or provider expertise levels (e.g., a sign that says, "Remember to Praise!" for those who know how, vs. one that gives scripted examples for those who do not). And knowledge should be structured in such a way so as not to inhibit run-time control and adaptation (e.g., modular units in a curriculum for provider training).

Thus far, little has been said about prioritizing among the knowledge from within and across different sources. What if the treatment manual says one thing (these are the steps to a treatment that works), but the individual case scores say another (this treatment is not working)? What if two different treatment approaches offer conflicting recommendations? An important aspect of the collaborative design infrastructure involves outlining coordination models that articulate a shared value system to impose a hierarchy of knowledge within sources (e.g., one might rationally decide a priori that randomized trials are preferable to uncontrolled trials within the treatment outcome knowledge base in Figure 2) and across sources (e.g., one might decide that evidence of client progress is prioritized over fidelity to a particular treatment manual when deciding whether to continue with the current treatment plan). These coordination models are typically represented in a process or flow that links decisions to their preferred knowledge resources (acknowledging their implicit hierarchies) and indicates preferred actions based on the decision being made and the knowledge being used (e.g., if client scores indicate progress, continue with the treatment; if not, move to the next decision in the model). In our earlier work, we have outlined examples of such models (Daleiden & Chorpita, 2005), which invoke the concept of wisdom, a term often used to describe how knowledge is prioritized (determining which knowledge to use for which decision; Rowley, 2007).

How is this different? Collaborative design emphasizes managing premises to decisions and actions rather than prescribing the decisions and actions themselves (see Figure 2, left side of dashed line). In other words, if the appropriate individuals are involved in the collaboration within a shared value system, and they are broadly and efficiently informed by the best knowledge, which includes opportunity for cueing, feedback and self-correction, we may be comparatively less concerned with the details of what happens to the right side of the line. This is in contrast to both the EBT paradigm, which typically prioritizes a single knowledge base (treatment research; Figure 2) and enforces strict controls on the decisions and actions to the right of the dashed line, and the individualized care paradigm, which encourages controls through coordination of only the social decision-making structures and processes (e.g., family treatment teams) and typically prioritizing local knowledge (e.g., individual case; Figure 2).

Implications for training. These concepts are not limited to direct service. Professional development models should similarly allow for run-time control, which could include asynchronous, modular learning frameworks that accommodate different points of development, outline standard learning pathways, and manage exceptions to those pathways. To complement our illustrations of such models within direct service (Daleiden & Chorpita, 2005), Figure 3 illustrates a collaborative design infrastructure organized for key decisions encountered in the context of provider professional development, specifically, a supervisor working with a direct service provider. Diamonds in the center represent a sequence of questions to guide supervisory activities, which are in turn outlined in rectangles on the right side of the figure. Stacked shapes on the left side of the figure represent knowledge to be referenced in the service of each decision, which is typically delivered or messaged through a structured knowledge resource. For example, portfolios in Figure 3 refer to a structured record that illustrates a supervisor's or provider's experience and expertise in a direct service or supervisory curriculum, respectively, thus giving an index of professional development progress. Like a "provider dashboard," the portfolio represents a parallel structure to the individual case feedback systems described in our earlier work (Chorpita et al., 2008). Supervisor guides on the right-hand side represent two-page checklists with corresponding detailed

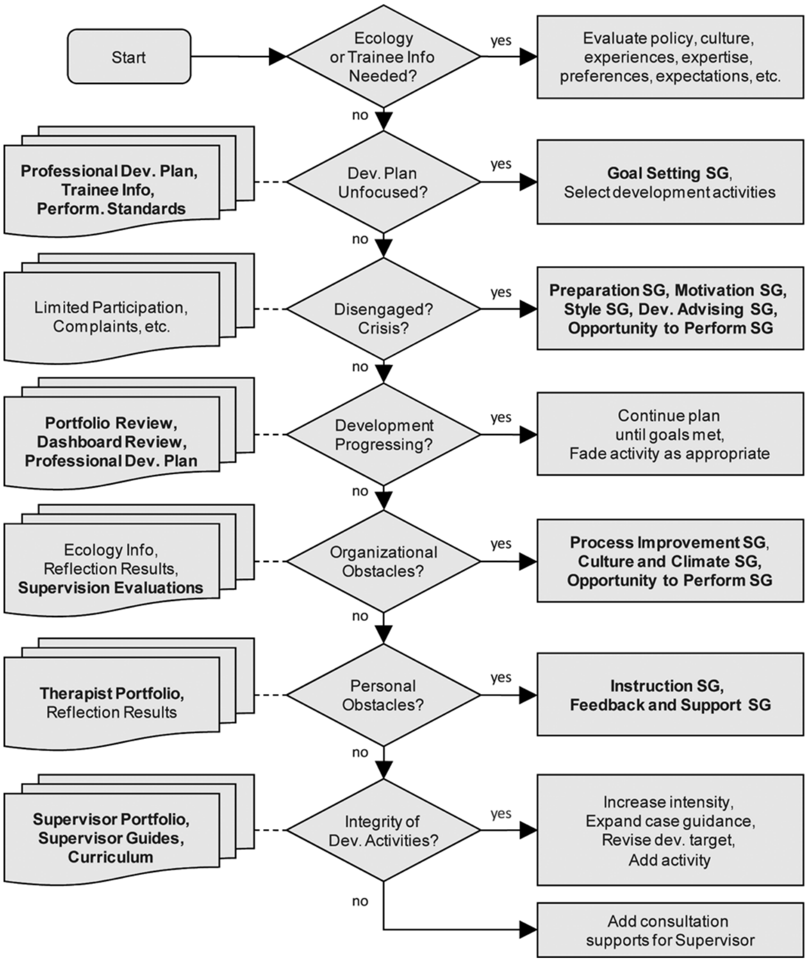

FIGURE 3 A process model coordinating key decisions, actions, and knowledge relevant to a supervisor's management of professional development activities with a supervisee. *Note*. Structured knowledge resources are in bold. Dev. = development; SG = Supervisor Guide. Adapted with permission, PracticeWise (2011).

strategies to guide supervision activity. Each guide (e.g., "Goal Setting," "Preparation") corresponds to an element of supervisory practices distilled from the general knowledge base on supervision. These supervisor guides follow a parallel structure to the clinical practice elements described in our earlier work (e.g., Chorpita & Daleiden, 2009). Thus, the principles of collaborative design can be applied to many aspects of system activity, beyond simply direct service.

SOME EXAMPLES

The Child STEPs Effectiveness Trial

Collaborative design was an implicit feature of a recently completed clinical trial performed with the Research Network on Youth Mental Health. The Child STEPs trial was a multisite randomized effectiveness trial performed in community-based service organizations (i.e., schools and clinics) in Hawaii and Massachusetts for 174 youths with anxiety, depression, or disruptive behavior problems. The investigation included three conditions, two involving evidence-based procedures and a third serving as the usual care control. In one of the evidence-based conditions, termed "standard," providers were trained in three EBT manuals, one for each of the three possible target areas of youth problems. In the second evidence-based condition, providers were trained in a single coordinated system of procedures called Modular Approach to Therapy for Children (MATCH; Chorpita & Weisz, 2009). In this study, MATCH was organized to contain the same types of procedures as the three evidence-based manuals in the standard condition, but MATCH allowed for these procedures to be flexibly arranged and applied according to various decision models or treatment pathways to accommodate differences in client status (e.g., treatment focus of depression vs. anxiety at baseline; a case ending sooner than others if improvement was noted) and to manage possible exceptions that emerged during the course of treatment. For example, if the child had anxiety, the MATCH treatment pathway would suggest starting with psychoeducation and engagement procedures followed by the building of a fear hierarchy and ultimately performing repeated exposure. If the treatment team (e.g., provider, family, supervisor), who were free to consider weekly outcome feedback organized on a clinical dashboard (individual case knowledge; Figure 2), collectively determined that other aspects of a case required significant attention (e.g., there were anger outbursts that were so interfering that they were preventing or disrupting the exposure therapy or homework), the provider would apply procedures from elsewhere in the MATCH library, such as a time out program or instruction for the parents in the effective use of commands or praise. In that sense, MATCH represented a collaborative service architecture that encouraged provider and client participation in the run-time control of the therapeutic plan but that also set investigator-defined, design-time standards for the performance of each procedure through codified modules and accordingly placed some limits on the degree to which providers could deviate from the logic of a traditional EBT algorithm.

Weisz et al. (2012) reported that youth treated in the modular condition improved at a significantly faster rate than youth in either the usual care or standard EBT conditions on measures of internalizing, externalizing, total symptoms, and severity ratings of family-nominated problems. Although one might be tempted to infer that flexibility in treatment was superior in this context, in fact the most flexible treatment condition, usual care, performed significantly worse than MATCH. Thus, it is more accurate to consider MATCH as achieving a balance that allowed evidence-informed, scientifically supported adaptation, creating a platform for both strategic and responsive application of evidence-based procedures.

Relevance Mapping

Thus far we have referred to collaborative design applications only within direct service and professional development contexts. However, service systems must contend with complex decisions regarding design as well: how to coordinate financing, training, utilization management, contracting and revenue, and policy. One design activity we have found to be ubiquitous in our endeavors in large systems is establishing an evidence-based array of services. Specifically, the task requires identifying which treatments are evidence based; determining which ones are most relevant to a particular service population; and, finally, choosing the smallest set of treatments that apply to the largest proportion of the service population. The logic is analogous to the parsimonious set covering method (Peng & Reggia, 1990) of identifying the smallest number of classes (e.g., diagnoses) that can be used to account for the largest number of observations (e.g., symptoms).

Selecting an optimal set of EBTs that fit well with a chosen service sample requires structured reasoning using at least two knowledge bases (see Figure 2): treatment research and aggregated cases. One should know which treatments are evidence based for which clients (e.g., based on age, problem type, etc.) as well as the client characteristics in the local service system (e.g., age, diagnoses, etc.). We recently demonstrated the application of this structured comparison, termed "Relevance Mapping" (Chorpita, Bernstein, & Daleiden, 2011), using a knowledge resource designed specifically for this purpose, which allows computer-automated comparison of each client in a system to the participant characteristics in hundreds of coded randomized clinical trials, comparing many trillions of possible service arrays representing all possible combinations of EBTs on the degree to which they cover the service population. Sets that serve the largest number of clients with the smallest number of EBTs are prioritized.

Our work so far shows that it is improbable for any service array composed entirely of EBTs to serve all members of a diverse public mental health system. For example, in our investigation with youths from the Hawaii state mental health system, two possible sets of nine treatments emerged as potentially covering the largest percentage of the service population, but each applied only to a maximum of 71% of the youths in the system. When stricter matching criteria were enforced (requiring EBTs to match not only on problem, age, and gender but also on ethnicity and setting), only 14% were coverable. Another notable pattern was that some treatments applied to a large percentage of youths (34% were coverable by Multisystemic Therapy), whereas others did not (five of nine treatments in the final set applied to 1% or less of the total service population).

The primary point relevant to the premise of this article is that we lack a critical piece of collaborative infrastructure servicing this important decision. Establishing a service array is a demanding process that typically involves large amounts of human and capital resources to produce answers with significant implications for public health and expenditures. Nevertheless, we have encountered service systems with dozens of EBTs available but that represent simultaneously redundant and incomplete coverage, such that a small portion of youths have more than one EBT available (e.g., multiple parent management training programs), whereas other youths have no EBT available matching their characteristics. We see this outcome in part as due to the lack of a defined knowledge resource for solving this computationally intensive problem.

A secondary point that these findings highlight is that most systems do not have a direct service mechanism for run-time exception management (or even detecting these exceptions systematically), which at the system level includes those youths for whom there is no EBT available in the service array. Although Relevance Mapping points to optimal sets, many service systems we have encountered have only one or two EBTs in place due to resource or administrative constraints, often leaving a substantial portion of the population—the "exceptions"—to be served by usual care. Thus, a second critical missing piece of system infrastructure is a method for designing promising treatments for those youths who have no options available in the service array or who have not responded successfully to options within that array.

Managing and Adapting Practice

In an effort to address the problems of coordinating multiple EBTs as well as to provide a consistent framework to serve youths who are either not covered by or unsuccessful exceptions to the EBTs in a given service array, we embarked on our most significant effort to date to build an explicitly collaborative, empirically informed system, which includes direct service, supervision, consultation, professional development, and quality management components, known as the Managing and Adapting Practice (MAP) system. MAP's underlying concepts and infrastructure drove system design and performance improvement initiatives of our work in the Hawaii system of care (e.g., Chorpita et al., 2002; Daleiden & Chorpita, 2005; Daleiden, Chorpita, Donkervoet, Arensdorf, & Brogan, 2006), informed much of the architecture of the MATCH protocol and its implementation process in the Child STEPs trial (Chorpita et al., 2008; Chorpita et al., 2008; Chorpita & Weisz, 2009), and have been increasingly refined and formalized over the past 10 years (e.g., Chorpita & Daleiden, 2009, 2010).

MAP's direct service component is more like a treatment selection, design, implementation, and evaluation kit than a treatment itself. It is organized by set of core concepts and decision models and uses specialized knowledge resources to inform key decisions in service delivery. For example, it employs a structured, searchable database of hundreds of randomized clinical trials (PracticeWise Evidence Based Services Database; PWEBS) to help develop an initial treatment plan and support ongoing decision making. The PWEBS application can return all treatments at a user-defined strength of evidence that match a given youth's characteristics. In other words, if a treatment team wishes to know what treatments meeting a commonly used definition of "evidence based" are suitable for a 9-year-old girl with disruptive behavior, PWEBS returns lists of all matching trials, all matching treatments, an aggregate summary showing the relative proportions of treatment types (e.g., parent management training, problem solving training), settings (e.g., clinic, school), and formats (e.g., individual, group). Thus, MAP's direct service component guides the user to select an existing EBT if it is available in the system.

When such resources are not available or if a standard EBT has already been tried but the youth has not met established treatment goals (the two common exception management scenarios), the MAP user can then design a treatment using procedures that are common to all of the matching treatments (in this example of the 9-year-old girl, 30 evidence-based protocols tested in 26 randomized trials). Practices distilled from the aggregate literature ("common elements"; Chorpita, Becker, & Daleiden, 2007) are listed and sorted according to the relative proportion of specific elements common across all of those protocols (e.g., 64% of all evidence-based treatments matching this 9-year-old girl used a rewards procedure). Providers can organize those elements into a plan according to common coordination rules derived from the treatment outcome knowledge base (similar to the MATCH treatment pathways), and specific therapeutic activity is then guided by a Practitioner Guide, a "how-to" knowledge resource that codifies the important steps of performing each practice element.

Another central aspect of the MAP system is a unifying evaluation framework to track outcomes and practices. Client assessment and routine progress monitoring of client status and therapeutic practice generate and then update the individual case evidence base (see Figure 2). MAP does not require a specific measurement model but emphasizes the importance of relevant and rigorous measurement of progress and practice in clinical reasoning and coordinated care, with measures and the timing of their administration dictated by the nature of the decisions being made (e.g., if decisions will be made about adaptations to treatment, outcome measures must be gathered frequently enough to precede those decision points). Whether the user has selected a standard EBT to be delivered within the larger MAP context or has designed an evidence-informed plan from the relevant literature to manage a system exception, the service episode is always subject to real-time evaluation and, for those treatments that allow run-time adaptation, to self-correction.

To meet this aim, MAP uses clinical dashboards as a knowledge resource to organize and deliver messages from multiple evidence sources and multiple parties into a collaborative workspace (cf. Chorpita et al., 2008). Clinical dashboards present case context, progress, and practice history on a single display. Common messages that may be collected and represented on dashboards include (a) observed values from assessment events with youth, families, providers, or other parties; (b) treatment team practice plans or progress benchmarks for celebration or additional review; (c) research benchmarks of clinical cutoff scores, expected rates of change (e.g., Weersing, 2005), or expected best practice events such as session sequences from a treatment manual or practice elements retrieved from a PWEBS search; and (d) administrative indicators for change in eligibility status, time or volume-based utilization triggers for reauthorization or intensive review, and so on. Essentially, dashboards are a telecommunication tool that support feedback, feed forward, exploration, and simulation.

In this collaborative treatment design context, MAP's direct service component also provides a variety of coordination resources, called ''process guides,'' which detail the logic of decision making and planning regarding selected aspects of care. For example, a Treatment Planner guide prompts the provider to coordinate the episode of care through selecting a therapeutic focus, organizing practices from the literature into logical early, middle, and late phases of care (referred to as ''connect,'' ''cultivate,'' and ''consolidate'' phases), and building a list of procedures to have on hand for likely sources of clinical interference (e.g., discrete procedures to address comorbidity). A Session Planner guide formalizes the planning and decision making regarding the structure of each session or clinical event, as well as important steps before and after, and yet another guide, called ''The MAP,'' offers an overarching model for clinical reasoning and service review throughout a service episode. An Embracing Diversity guide encourages the provider to engage in a structured consideration of possible adaptations to the plan, if indicated, across six different conceptual categories. Applications of this service architecture have been promising in terms of youth outcomes (e.g., Daleiden et al., 2006), but more important, the MAP system exemplifies a missing piece of system architecture: scientifically informed, personalized treatment options for youths who would otherwise be system exceptions.

CONCLUSION

The knowledge and technological developments in our field create great opportunity for advancing the coordination of our science and service systems. Ubiquitous examples of pain, suffering, tragedy, and misfortune in our society remind us of the importance of our goals of improving human functioning and yielding better lives for families and communities. Science offers a powerful strategy for managing the inevitable uncertainty in pursuit of these goals. We feel it is time to contemplate paradigmatic successors to our current strategies of EBTs and individualized care and to consider models that can preserve the strengths of these approaches but that might offer more. We contend that such models will emerge from consideration of the developmental complexity of systems, articulation of formal frameworks for organizing elements of those systems, and the development of better ways to balance design-time and run-time control in service models. We encourage the diverse collaborators in our field to reflect on these concepts and their illustrations both in this article and throughout this issue in the hope that we can collectively find new ways of moving forward.

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