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Sincerely,

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Evaluating the Cultural Environment and Organizational Support in Physician Opportunities

Physicians should proceed from the premise that their questions are expected — and, ideally, welcomed

By Bonnie Darves

The pandemic has had far-reaching effects in many areas of physician practice — namely added stress, job-security concerns, and emotional and psychological challenges for physicians at the front lines of care. This sustained disruption in the practice environment has also prompted many physicians to take a deep look into what matters most to them. That, in turn, has impelled some to reevaluate — even reorder — their priorities for the jobs they're in or the new opportunities they're considering.

While a good cultural fit and practice support structure have always been important, those two considerations, along with work-life balance, have begun to eclipse compensation on the wish-list scale, recruiters are reporting. "Of course, what constitutes a good fit is personal and individual for each physician, and what's important for residents coming out might differ from priorities for career physicians. But what we're seeing, since the pandemic, is that physicians are placing a higher priority on work-life balance and family concerns in opportunities they're considering than they might have before," said Emerson Moses, MBA, regional director for Clinical Talent Acquisition in Optum Health's Northeast, North Central, and Tri-State regions. "Many physicians are deciding, based on what they've experienced and witnessed in the past 18 months, that it's very important to live near family."

Physicians who are seeking a first or subsequent practice opportunity should have more than a vague idea of what they desire in setting, culture, and practice support, before they start actively interviewing, according to Kelley Hekowczyk, director of Physician Recruitment and Credentialing for UCHealth Medical Group in Loveland, Colorado. "Employers assume that if you reach out, you know what you're looking for in the culture and what you want your practice to look like. Ideally, you'll have a pretty good idea of that when you come to the recruitment process, so that you can match up the qualities you're looking for," said Ms. Hekowczyk.

Recruiters can be essential in both helping physicians focus their preliminary, "pre-interview" questions around factors that help reveal the culture of an organization — and in answering those queries early in the process, Ms. Hekowczyk reminds physicians. "The list of information that we as recruiters try to provide candidates is constantly evolving, but we do provide details on things like schedules, coverage, call backup, and mentoring. However, assessing the family [flexibility] issue can be a tough one," she said, that's best addressed in site interviews and open discussions with prospective colleagues.

Do ask *all* the questions on your mind

Even though it's hard to assess culture and physician support from afar — especially when onsite interviews and those all-important dinners with prospective colleagues haven't been possible — there are ways to get a sense of the practice environment, Ms. Hekowczyk maintained. She urges job-seeking physicians to review the organization's website thoroughly for evidence of cultural characteristics and then set one-on-one conversations with prospective physician partners. This can help physicians determine, she said, "whether the practice environment is one that they'll likely thrive in." In her organization, Ms. Hekowczyk noted, there's a strong emphasis on ensuring that candidates have ample opportunities to ask questions of their prospective colleagues — and all questions are fair game if they're important to the physician.

One of those culture questions has taken on new importance of late, Ms. Moses reports, and it's one that she thinks young physicians should ensure they ask: What is your strategy around physician well-being? "To some extent, it's a generational thing. Seasoned physicians may be willing to work themselves to the bone to make good money, but that's not core to this newer generation — the Generation Y and millennial physicians," she said. "They're hard workers, but they're also committed to having work-life balance."

Ms. Moses cautions that if an employing entity's interviewers appear reluctant to answer the "physician well-being" question, or if the question is received negatively, that might be a sign that the organization isn't focused on physician well-being. "Don't be afraid to ask all your important questions about culture — those questions are very important to finding a good fit," she said.

Lynne Peterson, president of the Association for Advancing Physician and Provider Recruitment and a 30-year veteran of physician recruiting, believes that cultural fit is too important a consideration for it to be shortchanged in the job-search process. "Physicians really need to look at both practice and organizational culture," said Ms. Peterson, senior director and ambassador of Provider Recruitment and Retention for Bluestone Physician Services in Stillwater, Minnesota. "At the practice level, that culture encompasses things like whether you like and trust prospective colleagues, and if you can be assured that they'll take care of your patients when you're not around."

Organizational culture is important for a different reason, Ms. Peterson explained. "You want to make sure that the organization truly supports the practice, that when executives talk to physicians, the physicians' voices are truly heard." Further, she said, physicians should try to find out, from prospective colleagues, whether "what the C-suite people say about doctors is borne out by physicians."

Assessing collegial environment and practice support

For invasive cardiologist Eks Wye Pollock IV, MD, at UCHealth in Fort Collins, Colorado, assurance of a culture of collegiality and having a good team were key considerations, along with a family-supportive environment, as he began looking for his first practice position. "That question was answered for me at each interview," he said of his experience at UCHealth, his first choice because of the university's standing and the practice's proximity to his extended family. "It was clear that the practice was collegial, and that the organization valued physician lifestyle and non-work time," he said. "I've since learned that other people I trained with aren't necessarily finding that in their jobs."

The team support in place became evident soon after Dr. Pollock started his job in 2019. Just a few months into the position, there was a death in his family. He emailed his colleagues, worried about getting his duties and patients covered while he was away. "Almost immediately, I received several emails from my team, and it was clear that everything would be taken care of," he said. "I was told when I joined that 'we're all here to help each other,' and I certainly experienced that."

Mary Ebbets, MS, a senior physician and Advanced Practice Provider (AAP) Recruiter at Cooley Dickinson Hospital, in Springfield, Massachusetts, echoes what Ms. Peterson says about teasing out the culture through pointed questions. But Ms. Ebbets also advises physicians leaving residency to ask about the overall practice-support environment, which can be key to ensuring both a good fit and longevity in the position. Some new residency graduates are

reluctant to do that for fear that they'll be seen as self-serving or demanding, recruiters report, but that's generally not the case. Ms. Ebbets suggested the following as good starting questions for gauging practice support:

- Will I have "mentor-type" access to senior physician colleagues?
- What kind of nursing and administrative support will I have in my daily practice life — is there a dedicated medical assistant and do we have APP support?
- What is the group's or hospital's policy regarding schedule flexibility for addressing family-life needs or requests?

"Remember that interviewing is like dating, so physicians should vet the organization just as much as the organization vets them — which means that physicians should ask all of the above questions," Ms. Ebbets said. "The only types of questions that cause my organization pause are questions or requests around patient volumes that are below the industry standard — such as physicians saying that they only want to see 10 patients a day."

Ms. Ebbets added that perhaps the most important question physicians should ask in assessing culture is: Why is this position available? If it's a "replacement" position, she said, physicians should be prepared to ask why the previous physician left and should expect a candid answer. If it's a new position based on growth, Ms. Ebbets added, the organization should be able and willing to supply market data to support the addition of another physician.

In posing key questions, be candid but cordial

In terms of how to phrase probing questions, Tom Farrington, MS, Director of Physician and Provider Services for Franciscan Physician Network in suburban Chicago and Indiana, offers some observations and guidance. First, he says, physicians should know that questions about work-life balance are common — and expected — these days. Likewise for detailed questions about training support and orientation, and the administrative support available. "I also believe that physicians want to know that demands on them to do burdensome administrative tasks are going to be minimal," he said.

Mr. Farrington suggests posing such questions in a diplomatic manner. "Questions phrased as 'help me understand the practice schedule, how call works, and the frequency of calls during coverage' are all fair questions that provide physicians information without them making overt demands,"

he said. On the other side of the spectrum, if physicians are asked to describe their ideal practice setting, they should supply a thoughtful, candid response. "That question is surely an opening for physicians," he said, to talk openly and honestly about what's important to them.

When internist Luis Gerald Lora Garcia, MD, was seeking his first post-residency practice position, he had specific needs and he made those known early in his search process. First, because he is on a J-1 Visa, he wanted to ensure that any practice he joined would be amenable and prepared to process his immigration. He also wanted to be close to a big city and to ensure that there would be some schedule flexibility and support from colleagues who were seeking a structure that enabled time for family and lifestyle pursuits.

In the end, Dr. Garcia found both at Franciscan Health's Valparaiso, Indiana, primary care clinic, the Franciscan Physician Network Health Center. He practices four 10-hour days, and he has enjoyed his proximity to Chicago and his ability to travel around the region and explore — activities he didn't have time for in residency. He admits that he has also found both a supportive culture and a collegial environment, and the ability to pursue his preferred clinical interests of cardiovascular-disease reduction and diabetes management. "It has worked out well so far, and I'm glad I was able to find an opportunity that meets my needs," he said.

When physicians do ask about what the clinical and administrative support they'll receive, they should expect detailed answers, according to Tammy Hager, MBA, Executive Director of Physician Recruitment and Privileging for Surgical Affiliates Management Group, Inc., in Sacramento, California. "When you're asking about staffing, you really should expect and be given some numbers behind that," she said, not just blanket statements suggesting that support will be adequate.

On the topic of collegiality, physicians should ask questions in a manner that calls for somewhat specific answers. Ms. Hager suggests inquiring about outside-work activities that physicians engage in, such as group dinners, boating excursions, or family get-togethers, for example.

For physicians who are trying to figure out whether they'll be a good fit within the existing group, it's not out of order to ask questions that will give the candidate a sense of the physician partners' diversity, backgrounds, and families. "If ethnic diversity is important to you, you might ask the recruiter where the other physicians live and where their children go to school. I think it's possible to do that without coming across as racially

biased," she said. She notes that the Association of American Medical Colleges (AAMC) maintains and publishes data on race, ethnicity, and gender patterns in US medical education and the practice patterns of the physician workforce in its Diversity in Medicine: Facts and Figures reports.

Finally, all interviewees agreed that while assessing culture and practice support are hugely important, physicians should ensure that the organization they're considering joining has the financial viability to keep them gainfully employed for the long term. That's become especially important in the wake of the pandemic's initial impact on health care organizations of all sizes. "More experienced physicians ask about things like whether there's a planned merger or acquisition that might affect their job, and whether there was an issue with layoffs or furloughs during the pandemic," Ms. Hekowczyk said. "But the younger ones don't tend to ask questions about the organization's financial position, but they should."

Ms. Moses urges physicians to do some research on the financial and market position — hospitals and health systems compile and publish data on their operating ratios, revenues, and cash reserves, for example — of any organization they're evaluating. Ideally, candidates will conduct their research before the interviews begin. Annual reports and other public published data are a good start, and local media coverage on market factors and financial problems can be telling, she said. "When you're doing this research, Google can be your friend, but physicians also shouldn't be afraid to ask questions about how the organization is positioned financially," she said, especially if it's a private practice.

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Unusual Parts of Compensation Packages

By Nisha Mehta, MD, *a physician leader whose work focuses on physician empowerment, community building, and career longevity in medicine*

In speaking to so many about their job offers, I've realized that we're often myopic in terms of what we think can be negotiated when discussing a contract. There are the traditional things everyone asks about — salary, bonus structure, call responsibilities, vacation schedule, and signing bonuses, to name a few. However, when talking to people about what their ideal job looks like, there's often more random things on a wish list. What we fail to realize is that those are all things that can be asked for, but that nobody else would even think to offer them to sweeten the deal.

Some examples of these?

- An early start and end to the day
- Dedicated academic or administrative time
- Unique FTEs such as 0.7 or unique structuring of their FTEs, such as alternating four- and two-day weeks
- Bonuses for creation of alternative revenue streams for the practice
- Changes in the amount of allotted CME money or money for office furnishings or technology
- The ability to work from home a certain number of days a week (for example, doing telehealth)
- A specified patient population according to their area of academic interest/desired practice panel
- An increased number of support staff such as scribes or medical assistants
- The speaker system which you will have in your operating room

Some of these may sound silly to you to ask for, but I know of physicians who have asked for and received these things as part of their contract negotiations. Remember, what brings happiness in your day-to-day life as a physician is very individualized, and therefore, asking for those things that will enhance your satisfaction (e.g., career longevity) at that job is not unreasonable.

Of course, asking for these things can be an art form. Understand that every institution has different flexibility or bandwidth for accommodating individual requests. You may want to look at what other accommodations have been made for other physicians on staff as precedent for what may be realistic prior to compiling your list of asks. Also, be careful about how many of these additional things you ask for. If you have 10 unusual requests, even if they are relatively minor, the message to the employer could be that this is a pattern of behavior where you will always be asking for exceptions to normal operating procedures.

Figure out which ones mean the most to you. Also figure out which ones are going to be harder to negotiate later, as your negotiating power is always greatest before you sign a contract. Be prepared to justify the asks so they understand why they would make accommodations. For example, if you are able to clearly articulate why something will lead to increased efficiency, lead to better patient outcomes, or contribute to your career longevity and prevent burnout, this would help your case. It would also help them to explain to others who question why these special accommodations were granted.

As demographics in medicine change, unusual asks will become more frequent. The sustainability of our health care workforce requires out-of-the-box solutions, and for some of you, these may be part of them! If you don't ask, you won't get it.

CLINICAL PRACTICE

Caren G. Solomon, M.D., M.P.H., *Editor*

Current Management of Glycemia in Children with Type 1 Diabetes Mellitus

Mark A. Sperling, M.D., and Lori M. Laffel, M.D., M.P.H.

This Journal *feature begins with a case vignette highlighting a common clinical problem. Evidence supporting various strategies is then presented, followed by a review of formal guidelines, when they exist. The article ends with the authors' clinical recommendations.*

A 12.5-year-old pubertal girl is referred to a tertiary medical center for management of new-onset diabetes mellitus. Her mother, a nursing aide, brought her to her pediatrician after noting excessive thirst, nocturia, and weight loss. The initial evaluation revealed glucosuria but no ketonuria; her blood glucose level is 288 mg per deciliter (16 mmol per liter). There is no family history of type 1 diabetes mellitus; her mother has hypothyroidism, and a younger brother is well. On examination, her weight is 40 kg (32nd percentile), height 150 cm (27th percentile), body-mass index (the weight in kilograms divided by the square of the height in meters) 17.8 (41st percentile), blood pressure 104/60 mm Hg, and pulse 78 beats per minute. She has Tanner stage 3 breast and pubic hair development. How would you evaluate and treat this patient?

From the Department of Pediatrics, Division of Endocrinology and Diabetes, Icahn School of Medicine at Mount Sinai, New York (M.A.S.); and the Pediatric, Adolescent, and Young Adult Section, Joslin Diabetes Center, and Harvard Medical School — both in Boston (L.M.L.). Dr. Sperling can be contacted at marksperling408@gmail.com or at the Department of Pediatrics, Division of Endocrinology and Diabetes, Icahn School of Medicine at Mount Sinai, 1 Gustave Levy Place, New York, NY 10029.

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THE CLINICAL PROBLEM

Type 1 diabetes mellitus is caused by the progressive autoimmune destruction of insulin-producing pancreatic beta cells initiated by as-yet-unconfirmed triggering events (e.g., potential viral infections) in persons who are genetically predisposed.[1-4] In the United States, the overall pediatric incidence of type 1 diabetes mellitus is approximately 25 per 100,000 per year and increased by 2 to 3% per year during the 2002–2012 period.[5] The incidence varies according to age (peaking in the pubertal years, ages 10 to 14), season (winter more than summer),[6] geographic location (Finland and other Nordic countries more than equatorial regions),[7] and race and ethnic group (U.S. non-Hispanic White persons more than Native Americans).[5] About 30 to 40% of patients present with diabetic ketoacidosis, a life-threatening medical emergency.[2,5,8] Genetic studies show a preponderance of genes regulating immune response, especially HLA DR3-DQ2 and DR4-DQ8, which account for some 50% of the hereditary predisposition; however, only approximately 10% of patients with new-onset disease have a first-degree relative with type 1 diabetes mellitus.[9] Circulating autoantibodies to islet cell components[3,4,10] and glycemic criteria[1,2,11] that are used to classify and stage diabetes are shown in Table 1.

STRATEGIES AND EVIDENCE

INSULIN REQUIREMENTS

Because type 1 diabetes mellitus is associated with eventual near-total deficiency of endogenous insulin secretion, this disease predicts a lifelong dependence on

KEY CLINICAL POINTS

CURRENT MANAGEMENT OF GLYCEMIA IN CHILDREN WITH TYPE 1 DIABETES MELLITUS

- Type 1 diabetes mellitus is one of the most common chronic diseases of childhood, with incidence increasing worldwide.
- Control of glucose levels to near normal reduces the risk of long-term microvascular and macrovascular complications.
- Newer biochemically modified insulins have durations of action ranging from very long (24 hours of basal insulin level) to ultrarapid (for glycemic control at meal or snack times).
- Technologies that have improved management of type 1 diabetes mellitus in children include continuous glucose monitors that replace painful fingerstick glucose checks, smart insulin pen injectors that receive data from continuous glucose monitors and assist with insulin dose calculations, and improved formulations of glucagon for autoinjection or nasal administration.
- Newer hybrid closed-loop systems combine an insulin pump, a continuous glucose monitoring device, and control algorithms that automate insulin delivery to maintain glucose levels within predetermined ranges and avoid hypoglycemia or hyperglycemia.
- High costs of newer insulins and diabetes technologies reduce their universal accessibility, resulting in disparities that warrant remedy.

exogenous insulin tailored to simulate endogenous insulin secretion. Endogenous insulin secretion is characterized by a relatively constant basal rate that is sufficient to restrain hyperglycemia or hypoglycemia interprandially and intermittent short bursts of insulin secretion of 1 to 2 hours' duration after meals, with peaks proportional to the quantity and composition of the ingested meal, augmented by gut-derived incretins.[12]

BENEFITS OF TIGHT GLYCEMIC CONTROL

The Diabetes Control and Complications Trial showed that glycemic control within near-normal glucose concentrations throughout a 24-hour period substantially reduced the risk of diabetic microvascular complications in proportion to the degree of euglycemia that was reached, although it increased the risk of hypoglycemia.[13] Moreover, longitudinal observational follow-up supported a carry-forward benefit associated with tight glycemic control (metabolic memory) extending to macrovascular disease, with a 42% reduction in cardiovascular disease events over a mean 17-year follow-up.[14,15] Current recommended glycemic targets for children with type 1 diabetes mellitus[16] are summarized in Table 2.

INITIATION OF TREATMENT

The initial phase of treatment includes stabilization of glucose levels and education of the patient and family about self-monitoring of blood glucose, techniques for insulin injection, dose calculations, principles of nutrition, interpretation of glucose levels, and management of hypoglycemia. Guidelines recommend that children with type 1 diabetes mellitus should receive care at a pediatric diabetes and endocrine center from a certified diabetes care and diabetes education specialist, nurse, nutritionist, and psychologist or social worker in addition to the pediatric endocrinologist.[16]

The combination of exogenous basal and bolus insulin delivery by injections and self-monitoring of blood glucose four to six times daily is the most common, practical means of initiating insulin treatment; the knowledge that patients gain from this approach also helps protect them if they subsequently begin insulin-pump therapy and the pump fails. Basal insulin levels are attained by using intermediate or, preferably, longer-acting insulin preparations; rapid-acting preparations cover meals and snacks and provide correction doses for hyperglycemia (Table 3).[17] Newer formulations of insulins and technologic advances have been developed that increase the likelihood that a patient will achieve better glycemic control. Such advances include continuous glucose monitors and devices for delivering insulin, such as smart insulin pens and mechanical or electronic insulin pumps (continuous subcutaneous insulin infusion) for programmable manual insulin delivery or partially automatic insulin delivery.[18]

CONTINUOUS GLUCOSE MONITORING

Continuous glucose monitoring eliminates the need for frequent, painful fingerstick glucose checks to guide insulin dosing. Continuous glucose monitors include a subcutaneous sensor, a transmitter to receive the glucose signal, and a receiver (either freestanding or an app on a mobile device) that displays glucose levels and trends. Earlier continuous glucose monitoring systems required calibration with self-monitoring of blood glucose, but some current systems include factory calibration and thus have greater ease of use, accuracy, and safety (Table S1 in the Supplementary Appendix, available with the full text of this article at NEJM.org). Sensors are replaced every 7, 10, or 14 days (depending on the type); longer-lasting sensors that can function for up to 1 year are under development.[19] Consensus guidelines recommend that glycemic targets include a time in range (the time over a 24-hour period that the blood glucose level is in the reference range of 70 to 180 mg per deciliter) of more than 70%, amounting to approximately 17 hours per day.[20] Many U.S. centers currently start the use of a continuous glucose monitor on the

Table 1. Diagnostic Criteria for Diabetes Mellitus.*

Stage	Diagnostic Criteria†
Latent diabetes (Stage 1)	Presence of two or more autoantibodies and normal glucose levels
Impaired glucose tolerance (Stage 2)	Fasting plasma glucose level of 100 to 125 mg per deciliter (5.5 to 6.9 mmol/liter) or Two-hour plasma glucose level of 140 to 199 mg per decliliter (7.8 to 11.1 mmol/liter) during an oral glucose-tolerance test or Glycated hemoglobin level of 5.7 to 6.4%
Diabetes (Stage 3)	Fasting plasma glucose level of ≥126 mg per deciliter (≥7 mmol/liter) or Two-hour plasma glucose level of ≥200 mg per deciliter (≥11.1 mmol/liter) during an oral glucose-tolerance test or Random plasma glucose level of ≥200 mg per deciliter with symptoms of polyuria and weight loss or Glycated hemoglobin level of ≥6.5%

* Criteria are derived from the American Diabetes Association Diagnostic Guidelines.[1,2]

† Oral glucose-tolerance tests should be performed as described by the World Health Organization (using a glucose load containing anhydrous glucose of 1.75 g per kilogram, up to 75 g, dissolved in water). Autoantibodies to insulin, glutamic acid decarboxylase, islet antigen 2, and islet-specific zinc transporter are used for diagnostic confirmation; the presence of at least one of these confirms the diagnosis of type 1 diabetes mellitus.[10,11] The presence of two or more antibodies, in the absence of any abnormality in glucose, is classified as latent stage 1 diabetes, a diagnosis that provides an opportunity for preventive intervention before clinical symptoms and exhaustion of the insulin reserve.[4,10]

Table 2. Recommended Glycemic Target Levels for Children with Type 1 Diabetes Mellitus.

Time	Glucose Level
Fasting, including bedtime, nocturnal, and preprandial levels	70–126 mg/dl (3.9–7.0 mmol/liter)
Postprandial peak	180 mg/dl (10.0 mmol/liter)
Time in range, >70% of a 24-hour day*	70–180 mg/dl (3.9–10.0 mmol/liter)
Glycated hemoglobin	≤7.0% (≤53 mmol/mole)

* Values shown are based on continuous glucose monitoring. These targets are associated with a lower risk of complications and are consistent with targets adopted by the American Diabetes Association and National Institute for Health and Care 2 Excellence guidelines for adults.[16] Time in range that is maintained for 14 consecutive days corresponds to a glycated hemoglobin level of approximately 7.0%. A glycated hemoglobin level of <7.0% (<53 mmol/mole) is appropriate for most patients, but the level should be individualized to achieve as near to this target as possible without inducing hypoglycemia or undue stress for the patient and family. A history of adherence, access to technology (especially continuous glucose monitoring), and prompt recognition and correction of hypoglycemia influence the recommended target range.

Table 3. Insulin Preparations and Onset, Peak, and Duration of Effect.*

Insulin Duration and Type	Brand Name	Onset	Peak	Duration
		min	*hr*	
Short-acting				
Human regular insulin	Humulin, Novolin, and Insuman	30 to 60	2.0 to 4.0	5.0 to 8.0
Rapid-acting				
Insulin lispro	Humalog	15 to 30	0.5 to 2.5	≤5.0
Insulin aspart	Novolog	15	1.0 to 3.0	3.0 to 5.0
Insulin glulisine	Apidra	12 to 30	1.5	5.0
Faster rapid-acting				
Faster insulin aspart	Fiasp	15 to 20	1.5 to 2.2	5.0 to 7.0
Inhaled human insulin	Afrezza	12	0.5 to 0.9	1.5 to 3.0
Intermediate-acting U100				
NPH	Humulin and Novolin	1 to 2	2.0 to 8.0	14.0 to 24.0
Long-acting U100				
Insulin glargine	Lantus and Basaglar	NA	No peak effect	24.0
Insulin detemir	Levemir	NA	No peak effect	7.5 to >24.0
Insulin degludec	Tresiba	NA	No peak effect	42.0

* Adapted and modified from Hirsch et al.[17] NA denotes not applicable.

day of diagnosis and begin insulin-pump therapy later, often 6 months or more after diagnosis.

Randomized trials of the use of continuous glucose monitors in children, with or without pump use, have shown substantial benefits for glycemic control. As compared with self-monitoring of glucose, continuous glucose monitoring significantly, although modestly, improved glycated hemoglobin levels (adjusted difference, −0.37%) in persons 14 to 25 years of age[21]; among younger children 2 to 7 years of age, continuous glucose monitoring considerably reduced the time that glucose levels were less than 70 mg per deciliter (by about 40 minutes daily) and reduced parental fears of this outcome, although the use of continuous glucose monitors did not improve glucose time in range.[22] A meta-analysis of randomized trials that compared continuous glucose monitors with self-monitoring of blood glucose, some of which included children, showed significant reductions in glycated hemoglobin and severe hypoglycemia in the group that used continuous glucose monitors[23]; benefits among children appeared similar to those among adults. Similarly, lower glycated hemoglobin levels and lower incidence of diabetic ketoacidosis were observed with the use of continuous glucose monitors and insulin pumps in a large international pediatric cohort.[24] Studies of continuous glucose monitoring together with pump use report improved psychosocial outcomes and quality of life.[19,25-27]

INSULIN PREPARATIONS

Insulin preparations with distinct pharmacokinetic and pharmacodynamic characteristics are shown in Table 3.[17] Glargine, detemir, and degludec are the most common preparations of basal insulin used in the treatment of children and adolescents with type 1 diabetes mellitus. Neutral protamine Hagedorn (NPH) insulin is a less expensive and readily obtainable intermediate-acting insulin; however, the use of NPH usually requires two daily injections, whereas one daily injection is usually sufficient when glargine, detemir, or decludec is used. Degludec (U100 and U200) and glargine (U300) are the longest-acting of these preparations, each with a half-life of approximately 25 hours, a low peak-to-trough ratio, and a nearly flat action profile, which is often associated with less risk for hypoglycemia (Table 3).

Fast- or rapid-acting insulin preparations (e.g., lispro, aspart, and glulisine), in which chemical modifications of regular insulin enable more rapid onset of action, ameliorate the early postprandial hyperglycemia followed by hypoglycemia that is often seen with regular insulin. Rapid analogues have generally supplanted the use of the more traditional regular insulin and at times even allow for dosing immediately after eating (desirable for the very young or highly selective eater at risk for hypoglycemia if insulin is administered before eating). Generally administered 15 to 20 minutes before meals and snacks, doses of rapid-acting insulin constitute 50 to 60% of the total daily dose, with dose amounts based on the estimated carbohydrate content and insulin sensitivity as detailed in published guidelines.[28] The insulin-to-carbohydrate ratio provides insulin coverage for the meal or snack on the basis of how many grams of carbohydrate will be metabolized per unit of insulin, enabling an appropriate bolus of fast-acting insulin based on the estimated carbohydrate content.[28] The insulin sensitivity index, or correction dose, estimates the decline in glucose (in milligrams per deciliter) per unit of insulin to correct an elevated glucose level to the prescribed target range, generally 100 to 120 mg per deciliter.[28]

To facilitate appropriate insulin dosing, patients and their families must be educated about these principles, including how to estimate carbohydrate content; the limits can be used for manual calculations or entered into a smart pen, an app, or a pump or can be used in automated algorithms.[28] The effectiveness of insulin doses is determined by a review of glucose patterns observed from self-monitoring of blood glucose or a continuous glucose monitor.

Insulin doses are adjusted often in childhood owing to growth and development, when there are changes in eating habits or exercise, or with illness. Although these concepts are taught from the time of diagnosis, teaching self-management is an ongoing, interactive process involving the patient, family, and diabetes care and education specialist teams.

INSULIN DELIVERY DEVICES

Syringes and Pens

Standard syringes with needles to withdraw a determined amount from a vial of insulin are still used. Modern insulin pen injectors contain prefilled cartridges along with needle devices to inject the recommended amount. Both pens and syringes include options for dosing at half-unit increments, valuable when administering insulin to very young children. Current devices that are labeled as smart insulin pens are often linked to mobile apps that digitally record doses with the concurrent glucose values from a glucose-sensing device; smart insulin pens have been associated with better glycemic control and with lower projected lifetime health care costs than standard care in adults.[29,30] Smart pens have also been associated with reduced hypoglycemic events in children, although there was no difference in time-in-range in a pre–post comparison.[31] Pen injectors offer convenience in setting doses and in portability, ease of storage, and durability in that they maintain function and potency without the need for daily refrigeration. Competence in the correct use of insulin pens or syringes along with glucose monitoring is an integral part of family education.[32]

Insulin Pumps

Insulin pumps, first introduced more than four decades ago,[33,34] are increasingly used in children. Among children with type 1 diabetes mellitus who were included in a registry study conducted in endocrinology practices across the United States, almost two thirds were using pumps during the 2016–2018 period.[35] In a population-based observational study involving more than 30,000 pediatric patients, pump therapy was associated with significantly lower rates of severe hypoglycemia and ketoacidosis and lower levels of glycated hemoglobin than multiple daily injections.[36] A meta-analysis of randomized, controlled trials of continuous subcutaneous insulin infusion involving children and young adults 1 to 21 years of age showed lower levels of glycated hemoglobin with continuous subcutaneous insulin infusion than with multiple daily injections in five of the seven reports.[37] A subsequent updated meta-analysis confirmed these findings along with lower rates of severe hypoglycemia; however, relative improvements in glycated hemoglobin levels with continuous subcutaneous insulin infusion were fewer in trials that included multiple daily injections of rapid-acting insulin analogues than in those that included injections of regular insulin

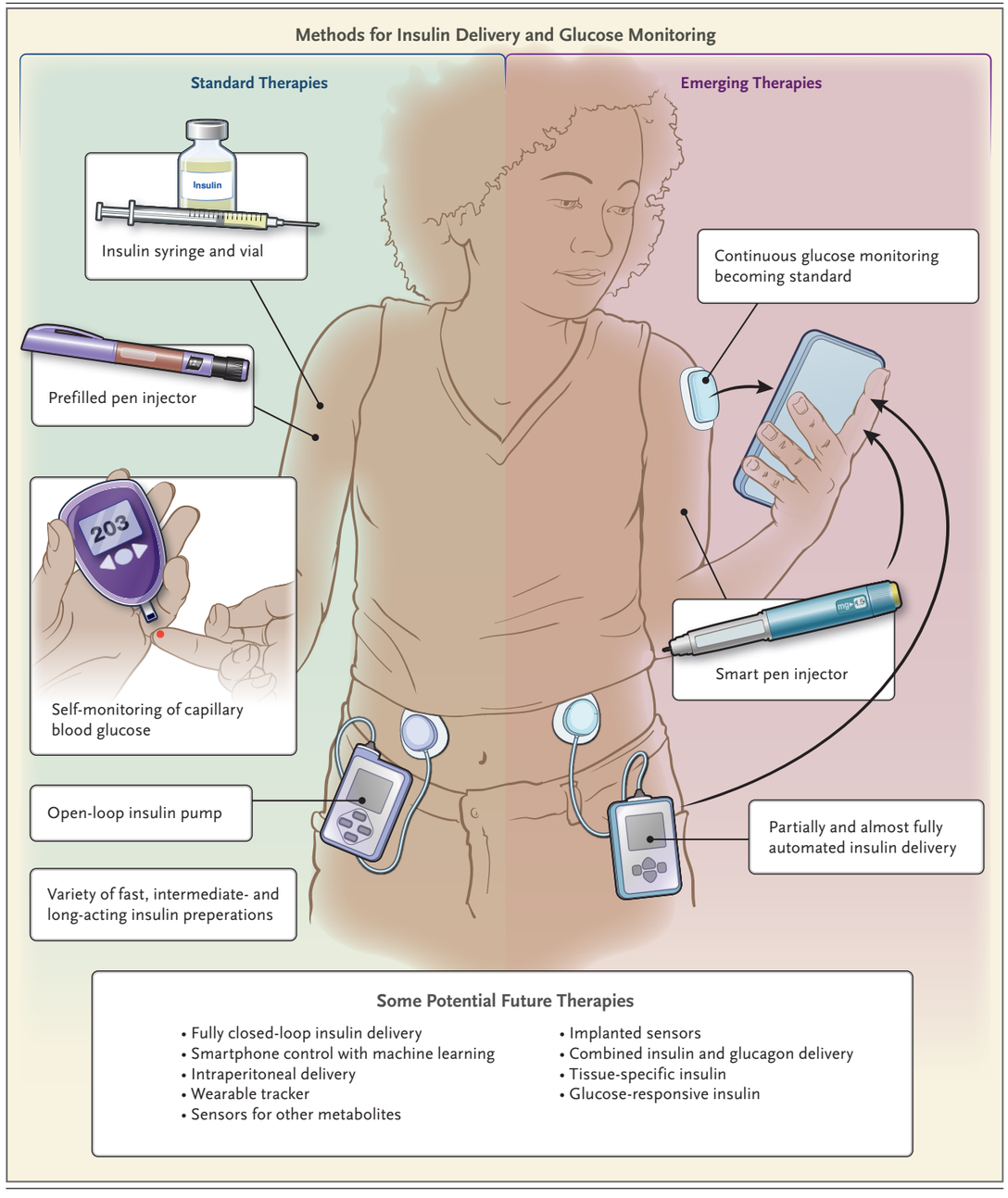

Figure 1 (facing page). Standard, Emerging, and Projected Future Therapies for Type 1 Diabetes Mellitus.

Standard therapies include insulin and syringes, separately or combined in pens, using basal and bolus insulin from currently available types. Self-monitoring of capillary blood glucose is recommended to be performed at least 4 to 6 times per day and is steadily being replaced by continuous glucose monitoring devices, which are less painful to use and provide more frequent, reliable information. Open-loop insulin-pump delivery devices that use regular or fast-acting insulin with manual inputting of basal, meal, and correction factor boluses by the wearer are now also considered consistent with standard therapy. Emerging therapies include continuous glucose monitoring, smart insulin pens that record administered doses and link to a display device that also may receive information from a continuous glucose monitor to track the effect and adjust future doses, and increasingly sophisticated hybrid closed-loop pump devices that approach a fully automatic closed-loop system.[18] Some potential therapies that may emerge in the future are described; other anticipated future therapies might include autologous stem-cell–derived islet transplants.[46]

(mean glycated hemoglobin difference, −0.29% vs. −1.93%).[38]

Improved communication between continuous glucose monitors and insulin pumps has yielded the next generation of advanced insulin delivery with automation. Such artificial-pancreas systems incorporate an algorithm that uses data from a continuous glucose monitor to direct insulin delivery.[18,19] The earliest sensor-augmented insulin pump yielded improved glycemic control.[39] The next advance provided for automated suspension of insulin delivery when the glucose level reached a predetermined low threshold. This was followed by predictive low-glucose suspension systems in which insulin delivery was reduced or suspended when glucose levels, as measured by continuous glucose monitoring, were predicted to be low. The most recent advances provide for automated increases in insulin delivery for elevated glucose levels above 180 mg per deciliter or for rising glucose levels that predict impending hyperglycemia. The automated insulin-delivery systems, known as hybrid closed-loop systems, assess the rate of change in glucose to guide increases and decreases in, or suspension of, insulin delivery. When these hybrid systems are used, the carbohydrate content of meals and snacks must be manually entered for bolus doses. Several hybrid closed-loop systems that have been approved by the Food and Drug Administration are currently in use, and others are in development.[18,19,40-43] Such systems use various algorithms to regulate the rate of basal insulin delivery to maintain glucose levels within the recommended range of 70 to 180 mg per deciliter day and night.[18] One approved system includes automated bolus doses to correct hyperglycemia; two 6-month randomized, controlled trials that included children showed improved glucose time in range and, in one trial, less hypoglycemia than with standard sensor-augmented pump therapy.[40,41] A recently approved tubeless system links a pod pump and a continuous glucose monitor with an algorithm built into the pod; the two devices communicate by Bluetooth wireless technology transmitting to a locked-down smartphone (a dedicated smartphone used only for the insulin monitoring and delivery system), which enables the hybrid closed-loop system. Studies that evaluated this system recently showed rates of diabetic ketoacidosis and severe hypoglycemia that were lower than those at baseline and lower than that in a cohort receiving multiple daily injections.[44,45] Standard, newer, and potential future treatments for children with type 1 diabetes mellitus are summarized in Figure 1.

NEWER GLUCAGON PREPARATIONS FOR HYPOGLYCEMIA

Severe hypoglycemia that results from insulin dosing errors, a missed meal or snack, or after exercise may cause loss of consciousness and seizure, resulting in fear among family members and barriers to attaining recommended glycemic targets. When a patient is unresponsive and unable to ingest oral glucose, treatment has traditionally required intramuscular or subcutaneous injections of glucagon, which needs reconstitution immediately before use. To surmount this problem, a new liquid, ready-to-use glucagon analogue has proved to be effective and is available for use in children 6 to 17 years of age.[47] A stable glucagon preparation is available in either prefilled syringes or an autoinjector and is approved for use in children as young as 2 years of age. An intranasally administered powder form of glucagon has also been approved for children 4 years of age or older; it is safe, effective, easy to use, and does not require reconstitution before use, which permits faster delivery, even by persons untrained in administering glucagon, for management of severe hypoglycemia.[48]

AREAS OF UNCERTAINTY

The cause of type 1 diabetes mellitus and reasons for its worldwide increase remain incompletely understood. In addition, adequately powered trials involving children are needed to

better show the effects of continuous glucose monitoring and pumps, including newer hybrid closed-loop systems, on short- and longer-term outcomes, including quality of life. Also, recent studies have indicated disparities in the allocation of pumps and continuous glucose monitors as well as disparities in glycated hemoglobin levels according to socioeconomic status[49-51] and race.[49] Moreover, costs of newer insulins are high and have also substantially increased in the United States[52]; effective strategies are needed to ensure equitable availability of insulin and newer technologies to a larger proportion of children with type 1 diabetes mellitus. Finally, it has been suggested that glycemic control by means of peripheral insulin infusion results in higher circulating insulin levels than portal delivery, which may in the long-term lead to deleterious effects,[53] a suggestion that supports further study of robust beta-cell–replacement strategies.

GUIDELINES

Guidelines and standards of care for children and adolescents with new-onset diabetes are published and regularly updated by the International Society for Pediatric and Adolescent Diabetes and the American Diabetes Association.[1,2] The current recommendations are consistent with these guidelines.

CONCLUSIONS AND RECOMMENDATIONS

The 12-year-old girl in the vignette had new-onset type 1 diabetes mellitus that was confirmed by the presence of beta-cell autoantibodies. Fortunately, her mother recognized the symptoms and appropriately sought care so that diabetic ketoacidosis was avoided. Living with diabetes affects the entire family and may disrupt life priorities; ongoing family support is important to ensure adherence to the treatment plan, especially during adolescence.[35,54] Consistent with guidelines, we recommend that the patient receive care at a pediatric diabetes and endocrine center that includes a certified diabetes care and education specialist.[16] She and her family should receive education about self-monitoring of blood glucose, insulin injection techniques, dose calculations, nutrition, glycemic targets, and management of hypoglycemia. We would initiate treatment with a basal–bolus program using insulin pen injectors — one for basal insulin and a smart pen for rapid-acting insulin to assist with insulin dose calculations. To allow the patient to avoid painful fingersticks, we would initiate use of a continuous glucose monitor, which is often available in a starter kit at specialty centers or as a pharmacy benefit. We would initially plan daily phone contact with the diabetes team for a period of several days to several weeks to review glucose profiles and provide family support, and then transition to quarterly follow-up visits. The occurrence of a so-called honeymoon phase, in which residual beta function temporarily improves, generally calls for reductions in insulin doses that may last 6 to 12 months. Since many children prefer using insulin pumps to reduce the number of daily injections and allow greater flexibility in their schedules, we would begin education about insulin-pump options within weeks to months after diagnosis and, if the family is interested, assist them in choosing a system. In view of the family history of autoimmune disease, we would encourage the family to consider enrolling the son in a research study that involves screening of relatives for risk of type 1 diabetes mellitus[55]; if the son is found to have two islet autoantibodies, he might be eligible for a trial of prevention methods for type 1 diabetes mellitus.[4,10]

Disclosure forms provided by the authors are available with the full text of this article at NEJM.org.

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- **Outpatient Primary Care**
  - **— Internal Medicine**
  - **— Family Medicine**
- **Pediatrics**
- **Pulmonary Medicine**
- **Psychiatry**
  - **— Adult**
  - **— Child**
- **Physiatry—Pain Management**
- **Reproductive Endocrinology**
- **Rheumatology**
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