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EDITORIAL

Progress in growth monitoring for infants born at term and preterm gestations: are we there yet?

Progresso na monitorização do crescimento de bebés nascidos a termo e em gestações prematuras: já lá chegámos?

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The first graphic display of pediatric growth was created by Count Philibert de Montbeillard (1720-1785), illustrating his own son's height progression[1]. With the accumulation of knowledge on population anthropometrics in the late 19th and early 20th centuries, growth charts have become essential reference tools for pediatricians in monitoring the development of growth parameters in their patients[1]. Anthropometric classification, a predicted growth trajectory for individual children, and the identification of deviations from said predictions are useful indicators of possible pathological conditions. To serve the individual child, growth standards must account for normal variation within a population, while enabling the early detection of changes that signal abnormal auxological trajectories in a particular child, e.g., when there is an unexpected crossing of percentile lines.

The tension between generalization and personalization is intrinsic to the construction of growth charts. For example, applying the World Health Organization's growth standards universally results in significant rates of misclassification or misdiagnosis among certain populations, particularly with respect to microcephaly[2]. Even more problematic is the prospect of representing growth across life stages, from fetus to newborn, to infant, to child, to adolescent, to fully grown adult. This difficulty is greatly exacerbated by preterm birth, when the newborn undergoes acute physiological water (and weight) loss, along with a phase of suboptimal nutrition. The variation in predominant determinants of growth trajectories in each life stage makes it impossible to utilize a single chart to track the entirety of an infant's growth. Instead, growth charts are restricted to specific age ranges, e.g., preterm neonates vs. infants vs. children. Because charts that encompass different age ranges are derived from different cohorts, merging charts through smoothing at the age transitions is statistically complex[3]. Moreover, rapid changes in the social environment and improvements in healthcare practices can affect anthropometric parameters even within two decades, requiring growth chart standards to be revised, as exemplified by children with Down syndrome[4,5] and neonates born preterm[3,6]. These issues have led to expressions of concern about the accuracy and usefulness of growth charts in both medical and lay publications[7].

The accuracy of auxological assessments can be improved by using specialized charts for specific target populations, whether these are based on diagnosis[5] or developmental stage, such as prematurity[3]. Understanding and using the panoply of infant growth charts available for various clinical purposes in the inpatient and outpatient realms presents a challenge to neonatal and pediatric clinicians.

To help practitioners negotiate this issue, the Portuguese Neonatal Society published updated guidelines for the use of infant growth charts in this issue of this Journal[8]. This is second time that these

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recommendations have been updated within a decade, and the new information should help clarify the purposes, advantages and limitations of each chart, while promoting consistency in the use of these rapidly evolving tools. Besides growth, there are now charts for neonates born at term, as well as those born preterm, which make it possible to assess whether postnatal weight loss is physiological or potentially pathological. The accessibility of these charts is facilitated by links, provided in the guidelines, to online versions of some charts, enabling clinicians to accurately assess any deviations in growth parameters, including z-scores, as well as print out individualized charts. Some of the chart-generating applications are open-access and downloadable. However, the ability to plot multiple points, or to save the data, is often limited. These shortcomings hinder the usability of these charts for serial assessments, deterring clinicians from adopting them into their routine workflow. Furthermore, the need to simultaneously use charts from different sources (e.g., the 2013 Fenton charts to monitor length and head growth in preterm newborns, while weight changes are tracked by a separate growth calculator) is another barrier to clinical efficiency. Integrating these tools into electronic medical records would facilitate their automated use, but this is largely restricted by legal and security considerations related to proprietary software. Clinicians must therefore choose the recommended charts for the purpose(s) currently intended and share the growth assessments when transitioning from one care provider to another in order to provide effective continuity in growth monitoring by subsequent caregivers[9]. This must be done on paper, unless clinicians in both settings can share raw growth data as part of a common healthcare system. Despite the progress in creating new charts, it remains unclear whether they are being used more broadly and effectively now than when the previous guidelines were published[10]. Applications within PediTools have been implemented successfully in some NICUs[11], but there is no published information on compliance with the routine use of these calculators in most hospitals.

Even though we have not yet achieved the consistent, widespread implementation of infant growth charts across the hospital and post-discharge stages of care, we are witnessing an accrual of knowledge that may eventually assist us in developing highly individualized charts. For term and late preterm neonates, combining weights from birth and postnatal day three with gestational age, sex, mode of delivery, type of feeding, maternal age, and parity yields a highly accurate prediction of weight change during the first week[12]. This is useful for both clinicians and parents to monitor the adequacy of breast feeding during the transition to home, but it may also enable clinicians to implement personalized milk fortification, including protein, early in order to optimize growth[13]. Ultimately, a holistic approach to nutritional management in infants will be needed, taking multiple factors into consideration in interpreting growth patterns[14].

It is soon likely that average parents who share Count de Montbeillard's interest in the growth of their child may simply access the child's growth data on their mobile device, input factors relevant to growth, and generate useful graphs that they can share with their pediatric care providers. This is already available in some mobile applications (e.g., www.mychart.org/Features/) and it allows parents to bridge some of the logistical communication gaps across care transitions. It seems likely that the Portuguese Neonatal Society will need to continue working on evaluating new versions of growth charts, recommending virtual dashboards for growth monitoring, guiding the implementation of these, and advocating for national policies that encourage the development of application programming interfaces to make growth data easily usable by all pediatric caregivers.

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