Temperature Measurement at Well-Child Visits in the United States

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Objective To determine the frequency and predictors of temperature measurement at well-child visits in the US and report rates of interventions associated with visits at which temperature is measured and fever is detected.

Study design In this cross-sectional study, we analyzed 22 518 sampled well-child visits from the National Ambulatory Medical Care Survey between 2003 and 2015. We estimated the frequency of temperature measurement and performed multivariable regression to identify patient, provider/clinic, and seasonal factors associated with the practice. We described rates of interventions (complete blood count, radiograph, urinalysis, antibiotic prescription, and emergency department/hospital referral) by measurement and fever (temperature ≥100.4 °F, ≥38.0 °C) status.

Results Temperature was measured in 48.5% (95% CI 45.6-51.4) of well-child visits. Measurement was more common during visits by nonpediatric providers (aOR 2.0, 95% CI 1.6-2.5; reference: pediatricians), in Hispanic (aOR 1.9, 95% CI 1.6-2.3) and Black (aOR 1.5, 95% CI 1.2-1.9; reference: non-Hispanic White) patients, and in patients with government (aOR 2.0, 95% CI 1.7-2.4; reference: private) insurance. Interventions were more commonly pursued when temperature was measured (aOR 1.3, 95% CI 1.1-1.6) and fever was detected (aOR 3.8, 95% CI 1.5-9.4).

Conclusions Temperature was measured in nearly one-half of all well-child visits. Interventions were more common when temperature was measured and fever was detected. The value of routine temperature measurement during well-child visits warrants further evaluation. *(J Pediatr 2021;232:237-42)*.

Temperature measurement and detection of fever are central to clinical decision making in pediatrics, as infectious diseases are among the most common diagnoses in children presenting to acute care settings.[1] Thus, temperature checks are embedded into routine vital sign measurement during clinical encounters. "Bright Futures," a national guideline for pediatric health promotion created by the American Academy of Pediatrics, emphasizes the importance of frequent preventive care visits to meet 4 main goals: health promotion, disease detection, disease prevention, and anticipatory guidance. The guideline recommends 12 scheduled well-child visits within the first 3 years of life, then annually through adolescence.[2] Recommendations for routine temperature measurement at well-child visits are not included.[2] Time constraints and reimbursement concerns for well-child encounters may pose additional challenges to physicians.[3-5] To improve the value and efficiency of well-child visits, it is important to investigate the evidence and risk-benefit profile of common practices performed at these encounters, including temperature measurement. Although routine temperature measurements may seem innocuous, the practice of temperature measurement among "well," asymptomatic children may lead to overdiagnosis, defined as the detection of "a true abnormality…[where] detection of that abnormality does not benefit the patient."[6] This can lead to adverse physical and psychological effects, such as further diagnostic interventions, vaccine deferral, and "fever phobia," or an exaggerated concern of the effect of fevers.[7]

Our study had 2 main objectives. First, we determined the frequency and predictors of temperature measurement at well-child visits. Second, in those encounters where temperature was measured, we investigated the prevalence of fever and rates of associated interventions.

Methods

We conducted a retrospective cross-sectional analysis using the National Ambulatory Medical Care Survey (NAMCS),[8] a publicly available dataset from the National Center for Health Statistics, which includes data from surveys of nonfederally employed practicing outpatient physicians across the US. The sampling unit is the patient-physician encounter. NAMCS uses a 3-stage sampling design and samples by geography, physician specialty, and patient visits. Systematic random samples are selected at predetermined rates of patient visits within a

CBC	Complete blood count
ED	Emergency department
NAMCS	National Ambulatory Medical Care Survey

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randomly assigned 1-week period. Sampling rates were based on clinic size.[9] Samples were then weighted by a multistage estimation procedure to provide national estimates.[10] Data include patient (eg, demographics, vital signs, diagnoses, studies, and treatment), provider (eg, subspecialty), and clinic (eg, region) information.[11] Temperature value documentation was included in the data beginning in 2003. For encounters with missing race or ethnicity data, we used imputed values provided by NAMCS, which conducted model-based single imputation for these variables from 2009 onward.

Study Population

We included well-child visits for children <18 years old seen by primary care providers (pediatricians, family medicine, or internal medicine practitioners) from 2003 to 2015. The NAMCS survey structure has 2 fields filled out by the provider that allow for identification of well-child visits: "reason for visit" and "major reason for visit." "Reason for visit" is a free-text field. A provider may list up to 5 reasons, and the first one is labeled as "most important" on the data collection instrument. "Major reason for visit" allows the choice of one of the following types of visits: "new problem (<3 months onset)", "chronic problem, routine," "chronic problem, flare-up," "pre-surgery," "post-surgery," and "preventive care (eg, routine prenatal, well-baby, screening, insurance, general examinations)." Our study population included visits where the first "reason for visit" was coded as "general medical examination" or "well-baby examination" and/or visits where "preventive care" was chosen for the "major reason for visit." Given the retrospective nature of this research, we decided not to exclude well-child visits associated with other "reasons for visit" because we were concerned that fever detection and/or interventions pursued, both outcomes of interest, may lead to a clinical diagnosis that would be excluded if listed as a "reason for visit."

Outcomes and Covariates

The primary outcome was temperature measurement, which was defined as documentation of a temperature value in the temperature field of the visit record. If no value was documented, temperature was classified as not measured. To determine predictors of temperature measurement, we selected patient-, provider/clinic-, and seasonal-level factors a priori. Patient-level factors included age, sex, race/ethnicity, and insurance status. Provider-level factors included specialty and clinic-level factors including region of clinic. Season of the well-child visit was also included. Patient insurance status was categorized as private, government (Medicare, Medicaid, Children's Health Insurance Program, or other state-based programs), or "other" (charity, self-pay, or other/unknown). Individual patient, provider, and clinic information are not able to be linked in NAMCS to protect confidentiality.

Our secondary outcome was receipt of the following interventions: a complete blood count (CBC), urinalysis, radiograph, emergency department (ED)/hospital referral, or antibiotic prescription. These interventions were chosen because they are common interventions in response to fever detection in general pediatrics. Other relevant diagnostic tests such as blood culture and viral nasopharyngeal swabs were not included because data were unavailable for all 13 years of this study. Fever was defined as a temperature ≥100.4 °F (≥38.0 °C). Thermometer route for temperature measurement was not documented in NAMCS.

Statistical Analyses

For the primary outcome of temperature measurement, we calculated frequency with 95% CI. To determine predictors of temperature measurement, we conducted χ^2 tests for the bivariable analysis and multivariable logistic regression including all covariates described above. We calculated ORs with 95% CI for both unadjusted and adjusted analyses. For the second aim examining the association between temperature measurement and interventions, we used χ^2 statistics to compare the proportions of interventions pursued at visits with and without temperature measurement. In addition, we calculated the frequency of fever among visits with temperature measurement and compared the proportions of interventions in visits with and without a documented fever. A *P* value of <.05 was considered statistically significant. We also performed multivariable logistic regression to determine the relationship between the practice of temperature measurement and receipt of ≥1 interventions of study, adjusting for all covariates included in the analysis of our primary aim. Among patients who had temperature taken, we performed a multivariable regression to determine the relationship between fever status and receipt of ≥1 interventions of study, again adjusting for the same covariates included in the analysis for our primary aim. Finally, we explored the top diagnoses other than "well-child visit" and "fever" for visits associated with fever and antibiotic prescriptions posthoc. All analyses were conducted using Stata/SE v 15.0 (StataCorp) and used the survey weights provided by NAMCS, which accounted for the complex survey design necessary to generate national estimates.

Results

Frequency of Temperature Measurement

From 2003 through 2015, there were 22 518 sampled well-child visits recorded in NAMCS, representing a weighted estimated 671 million well-child visits (95% CI 626-716) nationally. This averaged to 52 million visits annually. The median patient age was 2 years (IQR: 0.6-9 years old) and 52.2% were male (Table I); 14% were younger than 90 days old. Temperature was measured in 48.5% (95% CI 45.6-51.4) of encounters.

Predictors of Temperature Measurement

Bivariable Analysis. Bivariable analyses revealed that temperature measurement was more common in Hispanic and non-Hispanic Black patients when compared with non-

Table I. Number and percentage of annual well-child visits, by temperature measurement, 2003-2015

Average annual number of visits in millions (n*,†, %‡)

Characteristics	Total	Temperature measured	Temperature not measured	$P(\chi^2)$
Patient				
Age category				.16
0-30 d	3.9 (7.5)	1.8 (7.2)	2.1 (7.7)	
31-60 d	1.5 (3.0)	0.7 (2.8)	0.9 (3.2)	
61-90 d	2.0 (3.9)	1.0 (4.1)	1.0 (3.6)	
91 d to 1 y	15.5 (30.1)	7.7 (30.9)	7.8 (29.4)	
2-5 y	10.5 (20.3)	5.2 (20.7)	5.3 (20.0)	
6-17 y	18.2 (35.3)	8.6 (34.4)	9.6 (36.2)	
Sex				.06
Male	27.0 (52.2)	12.8 (51.3)	14.1 (53.1)	
Female	24.7 (47.8)	12.2 (48.7)	12.5 (46.9)	
Race/ethnicity				**<.001**
White, non-Hispanic	27.2 (59.7)	11.7 (51.7)	15.5 (67.6)	
Black, non-Hispanic	5.3 (11.7)	3.2 (14.1)	2.1 (9.3)	
Hispanic	9.7 (21.2)	6.2 (27.5)	3.4 (15.0)	
Other, non-Hispanic	3.3 (7.4)	1.5 (6.7)	1.8 (8.1)	
Insurance status§				**<.001**
Government	14.7 (33.1)	9.3 (42.1)	5.4 (24.2)	
Private	26.5 (59.5)	10.9 (49.3)	15.6 (69.5)	
Other	3.3 (7.5)	1.9 (8.6)	1.4 (6.4)	
Clinic/provider				
Subspecialty				**<.001**
Pediatrics	42.8 (82.9)	19.8 (79.0)	23.0 (86.6)	
Nonpediatrics	8.8 (17.1)	5.2 (21.0)	3.6 (13.4)	
Region				**<.001**
West	12.2 (23.7)	6.0 (23.8)	6.3 (23.6)	
Midwest	10.9 (21.0)	5.0 (20.0)	5.8 (22.0)	
South	17.8 (34.6)	10.3 (41.3)	7.5 (28.2)	
Northeast	10.7 (20.7)	3.7 (14.9)	7.0 (26.2)	
Temporal				
Season				.36
Winter	11.4 (22.0)	5.9 (23.7)	5.4 (20.4)	
Spring	12.8 (24.7)	6.0 (24.1)	6.7 (25.3)	
Fall	11.7 (22.7)	5.8 (23.1)	5.9 (22.3)	
Summer	15.8 (30.6)	7.3 (29.1)	8.5 (32.0)	

Bolded values represent statistically significant values ($P < .05$; confidence intervals ≤1.0).
*Number of visits where temperature was and was not measured may not add up to the total number of visits because of rounding to the nearest 0.1 million.
†Data are weighted using NAMCS weights.
‡Column percentages may not add up to 100% because of rounding.
§"Private" includes private insurance only. "Other" includes charity, self-pay, or other/unknown. "Government" includes Medicare, Medicaid, Children's Health Insurance Program, or other state-based programs.

Table II. Characteristics associated with temperature measurement at well-child visits*

Characteristics	Proportion with temperature measurement (%, 95% CI)	Unadjusted OR (95% CI)	aOR (95% CI)†
Patient			
Age category			
0-30 d	47 (42-51)	Reference	Reference
31-60 d	45 (38-52)	0.9 (0.7-1.2)	0.9 (0.7-1.2)
61-90 d	52 (46-48)	1.2 (1.0-1.6)	1.2 (0.9-1.5)
91 d-1 y	50 (46-53)	1.1 (0.9-1.3)	1.2 (0.9-1.4)
2-5 y	49 (46-53)	1.1 (1.0-1.3)	1.2 (1.0-1.4)
6-17 y	47 (44-50)	1.0 (0.9-1.2)	1.1 (0.9-1.4)
Sex			
Male	48 (45-51)	Reference	Reference
Female	50 (46-53)	1.1 (1.0-1.2)	1.1 (1.0-1.2)
Race/ethnicity			
White, non-Hispanic	43 (40-46)	Reference	Reference
Black, non-Hispanic	60 (54-65)	**2.0 (1.6-2.5)**	**1.5 (1.2-1.9)**
Hispanic	64 (60-69)	**2.4 (2.0-2.9)**	**1.9 (1.6-2.3)**
Other, non-Hispanic	45 (39-51)	1.1 (0.8-1.4)	1.1 (0.8-1.4)
Insurance status			
Private	41 (38-45)	Reference	Reference
Government	63 (59-67)	**2.5 (2.0-3.0)**	**2.0 (1.7-2.4)**
Other‡	57 (50-64)	**1.8 (1.4-2.6)**	**1.6 (1.1-2.1)**
Clinic/provider			
Subspecialty			
Pediatrics	46 (43-50)	Reference	Reference
Nonpediatrics§	60 (56-63)	**1.7 (1.4-2.1)**	**2.0 (1.6-2.5)**
Region			
Northeast	35 (29-40)	Reference	Reference
West	49 (43-54)	**1.8 (1.3-2.5)**	**1.7 (1.2-2.4)**
Midwest	46 40-52)	**1.6 (1.1-2.3)**	**1.7 (1.1-2.5)**
South	58 (52-63)	**2.6 (1.8-3.6)**	**2.5 (1.7-3.5)**
Temporal			
Season			
Winter	52 (47-57)	Reference	Reference
Spring	47 (42-53)	0.8 (0.6-1.1)	0.8 (0.6-1.1)
Fall	49 (44-54)	0.9 (0.7-1.2)	0.9 (0.7-1.3)
Summer	46 (41-52)	0.8 (0.6-1.0)	0.7 (0.5-1.0)

Bolded values represent statistically significant values ($P < .05$; confidence intervals ≤1.0).
*Data are weighted using NAMCS weights.
†Our multivariable regression model included all the characteristics listed above and includes 20 526/22 518 (91.2%) encounters because of missing data on insurance status and race/ethnicity. Insurance status data was missing in 1992 (8.8%) and race/ethnicity data was missing in 1500 (6.7%) encounters.
‡"Other" includes self-pay or charity.
§"Nonpediatrics" includes internal medicine and family medicine providers.

Hispanic White patients, at visits by nonpediatric providers compared with pediatricians, and in patients receiving government insurance compared with the privately insured (Table II). Temperature measurement was more common in the West, Midwest, and South when compared with the Northeast.

Multivariable Analysis. In multivariable analysis, temperature measurement was still more common at well-child visits for Hispanic (aOR 1.9, 95% CI 1.6-2.3) and non-Hispanic Black (aOR 1.5, 95% CI 1.2-1.9) patients when compared with non-Hispanic White patients, and at visits for patients with government vs private insurance (aOR 2.0, 95% CI 1.7-2.4) (Table II). Temperature measurement was more common in visits seen by nonpediatric providers than those with pediatric providers (aOR 2.0, 95% CI 1.6-2.5). Visits in the West (aOR 1.7, 95% CI 1.2-2.4), Midwest (aOR 1.7, 95% CI 1.1-2.5), and particularly the South (aOR 2.5, 95% CI 1.7-3.5) were associated with higher rates of temperature measurement compared with visits in the Northeast. Age, sex, and season of encounter were not associated with temperature measurement in bivariable or multivariable analysis.

Rates of Associated Interventions

Interventions by Temperature Measurement. Table III describes the percent of well-child visits associated with interventions by the practice of temperature measurement. In bivariable analysis, receipt of ≥1 interventions

Table III. Percent of well-child visits with interventions, by temperature measurement*

	Temperature measured (%)	Temperature not measured (%)	*P* value	aOR† (95% CI)
≥1 intervention	17.4	15.0	.06	1.3 (1.1-1.6)
Urinalysis	8.6	8.1	.58	
CBC	8.3	6.7	.12	
Antibiotic prescription	4.0	2.6	**<.0001**	
Radiograph	0.9	0.4	**<.001**	
ED/hospital referral	0.07	0.04	.57	

Bolded values represent statistically significant values ($P < .05$; confidence intervals ≤1.0).
*Visits with and without temperature measurement arise from the total cohort of 22 481 sampled well-child visits (weighted estimated population: 670 million).
†This multivariable model controls for the following covariates: patient age, patient sex, patient race/ethnicity, patient insurance status, provider subspecialty, clinic region, season of encounter.

(urinalysis, CBC, antibiotic prescription, radiograph, and ED/hospital referral) was slightly more common in well-child visits where temperature was measured compared with visits where temperature was not measured (17.4% vs 15.0%, $P = .06$), but this difference was not statistically significant. Individually, antibiotic prescriptions (4.0% vs 2.6%, $P < .001$) and radiograph (0.9% vs 0.4%, $P < .001$) orders were more common at visits with temperature measurement compared with visits without temperature measurement. There was no significant difference between groups in terms of obtaining a urinalysis, CBC, or ED/hospital referral. After adjusting for the same covariates used for the analysis of our primary outcome of temperature measurement, temperature measurement was significantly associated with receipt of ≥1 interventions of study (aOR 1.3, 95% CI 1.1-1.6).

Interventions by Fever Status. Of well-child visits with temperature measurement, 1.0% (95% CI 0.6-1.3) had fever (≥100.4 °F) documented. Table IV describes the percent of well-child visits associated with interventions by fever status. A higher percentage of visits with documented fever were associated with at least 1 intervention compared with visits without fever (32.4% vs 17.2%, $P = .01$). Of the individual interventions, only antibiotic prescription was significantly more common in visits with a fever than visits without a fever (25.9% vs 3.8%, $P < .001$). For visits of febrile patients that were prescribed antibiotics, the top diagnoses other than "well-child visit" (54.6%) and "fever" (22.2%) were earache (3.0%), head cold (3.9%), and cough (4.9%). When adjusting for the same covariates as those used for the analysis of our primary outcome temperature measurement, fever was significantly associated with the receipt of ≥1 interventions (aOR 3.8, 95% CI 1.5-9.4).

Table IV. Percent of well-child visits with interventions, by fever status*

	Febrile (≥100.4 °F, ≥38.0 °C) (%)	Afebrile (<100.4 °F, <38.0 °C) (%)	*P* value	aOR† (95% CI)
≥1 intervention	32.4	17.2	**.01**	3.8 (1.5-9.4)
Urinalysis	8.5	8.1	.91	
CBC	9.6	8.3	.74	
Antibiotic prescription	25.9	3.8	**<.001**	
Radiograph	2.4	0.8	.26	
ED/hospital referral	0.01	0.07	.10	

Bolded values represent statistically significant values ($P < .05$; confidence intervals ≤1.0).
*Visits with documented fever and no fever arise from well-child visits where temperature was measured (11 483 sampled visits; weighted estimated population: 324 million).
†This multivariable model controls for the following covariates: patient age, patient sex, patient race/ethnicity, patient insurance status, provider subspecialty, clinic region, season of encounter.

Discussion

Based on representative data from a large, national sample, we found that temperature was measured in nearly one-half of well-child visits. Temperature measurement was more common in patients of Hispanic ethnicity, Black race, or with government insurance, and in visits with a nonpediatric provider. This practice was associated with increased interventions, particularly antibiotic prescriptions and radiographs, when compared with well-child visits at which temperature was not measured. These findings help us better understand the patterns and potential interventions associated with temperature measurement at well-child visits.

As there are currently no guidelines regarding temperature measurement in well-child visits, it is not clear why temperature measurement occurs so frequently. Although some measurements may be driven by concerns for infection, the magnitude of this practice suggests that temperature measurement may be part of standard protocols at some clinics. Routine measurement for both urgent and well-child visits could be viewed as more efficient than identifying which visits warrant initial temperature measurement with vital signs vs measurement later in the visit when requested by the provider. Some clinics or providers may measure temperature to guide decisions related to vaccine administration, even though the Centers for Disease Control and Prevention continues to recommend immunization during mild illnesses, even when patients have a low grade fever (<101°F, <38.3 °C).[12] Vaccine deferral was not documented in the NAMCS data, but future studies should explore whether the practice of temperature measurement impacts immunizations rates.

Temperature measurement at well-child visits was more frequent in patients with government insurance, which may be partly explained by regulatory requirements. Although Medicaid reimbursement guidelines vary at the state level, federal Centers for Medicare and Medicaid Services guidelines designed to provide a framework for "Evaluation and Management Services" recommend 3 of the following 7 vital signs for any setting, including ambulatory visits: sitting or standing blood pressure, supine blood pressure, pulse rate and regularity, respirations, temperature, height, and/or weight.[13] Further, the Social Security Act added an amendment in 1967 to incorporate Medicaid's federally mandated Early and Periodic Screening, Diagnostic and Treatment program aimed at providing comprehensive preventive care services to children <21 years of age.[14] Notably, temperature measurement is not specified as a required component of the well-child visit at the federal level. At the state level, most Medicaid programs reference "Bright Futures" recommendations to guide well-child visit schedules and clinical practices; these do not include a recommendation for routine temperature measurement at well-child visits.[2] However, some states may include temperature value documentation as a "critical component" of an Early and Periodic Screening, Diagnostic and Treatment well-child visit.[15] Therefore, temperature measurement may be occurring for compliance purposes or for consistency in temperature measurement protocols for all patients, regardless of insurance status.

The reason for more frequent temperature measurement in Hispanic and Black patients is unclear. Racial/ethnic differences have also been found between rates of blood pressure screening at well-child visits, with lower rates in Black and non-Hispanic patients compared with White and Hispanic patients, respectively.[16] However, these differences were not replicated in a study using NAMCS data.[17] Racial and ethnic differences have been documented in the diagnosis of common pediatric infections; most studies found that racial disparities exist in the diagnosis and management of infections that rely on clinical judgment for diagnosis, such as acute otitis media, upper respiratory tract infections, pharyngitis, hay fever, and sinusitis.[18-21] It is unclear if these differences may contribute to variation in temperature measurement screening. There may be residual confounding that could not be fully adjusted for in the model and observed differences in measurement practices may reflect clinic demographics. Nonpediatric providers tended to measure temperature more frequently than pediatricians did, which may be due to inherent differences in training and practice patterns between the 2 different subspecialties.

We found a small increase in the proportion of at least 1 intervention in visits associated with temperature measurement. It is possible that clinics that routinely measure temperature at well-child visits also tend to pursue interventions more readily. The association may also reflect an initial concern for infectious diseases, prompting both temperature measurement and intervention.

Fever defined as ≥100.4 °F (≥38.0 °C) was documented in 1% of patients at well-child visits where temperature was measured. Patients with fever were more likely to undergo at least 1 intervention, potentially triggered by concerns for infection, with antibiotic prescription as the leading intervention. Although patients with fever may have had a true infection (eg, acute otitis media) or symptoms warranting the intervention pursued, it is also possible that fever detected incidentally in asymptomatic patients may have led to misdiagnosis or overdiagnosis, thereby prompting unnecessary interventions. Aside from "well-child visit" and "fever," the most common diagnoses for well-child visits of febrile patients associated with antibiotic prescription were respiratory in nature (earache, head cold, and cough), consistent with a 2011 study on antibiotic prescribing practices in outpatient pediatrics clinics, where respiratory conditions such as otitis media, sinusitis, pharyngitis, and pneumonia accounted for 72% of antibiotic prescribing.[18] Antibiotic overtreatment has been well-described for most of these conditions. Garbutt et al showed that only 38% of pediatricians complied with the recommended diagnostic criteria of the Centers for Disease Control and Prevention for acute otitis media and had variable diagnostic approaches.[22] Visits in which a fever was detected in an asymptomatic child may have prompted physicians to investigate a cause, leading to increased diagnosis of conditions with variable criteria and subsequent antibiotic prescription. As individual chart review is not available through NAMCS, future research on the impact of temperature measurement at well-child visits should utilize detailed data including patient presentation to better understand reasons for interventions pursued when fever is detected.

This study investigated the frequency and predictors of temperature measurement at well-child visits using a nationally representative dataset with over 20 000 visits over a 13-year period to provide an overview of the practice of temperature measurement at well-child visits at the national level.

Our study also has several limitations. First, NAMCS lacked granular data from individual charts. It is possible that some of the measurements may have been triggered by patient symptoms. Although it is highly unlikely that clinical concerns would have prompted temperature measurements in nearly one-half of all well-child visits, we should remain cautious using the 1% frequency of fever as a true estimate of fever detected with routine temperature measurement. Furthermore, given that we were not able to ascertain symptoms reported at visits, all relevant factors affecting the decision to measure temperature may not be accounted for in our regression model. NAMCS data is dependent on physician documentation and providers may not have recorded temperature values even if obtained, which may have led to underreporting of temperature measurement and fever. Second, we cannot assess the contribution of individual clinic practices on the decision to measure temperature because NAMCS does not allow for the identification of individual clinics within the dataset. It is possible that the decision to measure temperature is made at the clinic level and that characteristics associated with temperature measurement reflect characteristics of clinics that are more likely to measure temperature. Third, the association between temperature measurement or fever and intervention may be confounded by the patient's specific symptom presentation, which we were not able to fully assess in this dataset. Because our study population did not exclude well-child visits with "reasons for visit" other than "general medical examination" or "well-baby examination," interventions pursued in response to patient symptoms may be included in our reported rate of interventions in well-child visits where temperature was measured and fever was detected. Fourth, the sampling unit for NAMCS is the patient-physician visit rather than the individual patient and results represent visit characteristics and frequency rather than patient characteristics and frequency. It is also possible that the same patient may be represented more than once having had multiple well-child visits sampled, although this is unlikely given the short 1-week sampling period during the last-stage of a 3-stage sampling design. Nonetheless, variation in patient characteristics within individual clinics could influence results at the visit level. Finally, as this was a cross-sectional analysis, we are unable to assess temporal trends contributing to temperature measurement practice and intervention patterns.

Future research should study the downstream effects of routine temperature measurement at well-child visits to inform the risk-benefit profile of this practice in asymptomatic children. As we strive to improve US healthcare value, it is imperative to better understand common practices, such as routine temperature measurement at well-child visits that may lack evidence and lead to overdiagnosis. Such findings can be used to develop guidelines related to temperature measurement practices at well-child visits, and to inform best practices for vital sign measurements as telehealth visits are becoming more common. ■

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Data statement

Data sharing statement available at www.jpeds.com.

References

1. Slora EJ, Thoma KA, Wasserman RC, Pedlow SE, Bocian AB. Patient visits to a National Practice-Based Research Network: comparing pediatric research in office settings with the National Ambulatory Medical Care Survey. Pediatrics 2019;118:e228-34.
2. Hagan JFJ, Shaw JS, Duncan PM, eds. Bright futures: guidelines for health supervision of infants, children, and adolescents. 4th ed. Elk Grove Village, IL: American Academy of Pediatrics; 2017.
3. Schor EL. Rethinking well-child care. Pediatrics 2004;114:210-6.
4. Bethell C, Reuland CHP, Halfon N, Schor EL. Measuring the quality of preventive and developmental services for young children: national estimates and patterns of clinicians' performance. Pediatrics 2004;113: 1973-83.
5. Coker TR, Thomas T, Chung PJ. Does well-child care have a future in pediatrics? Pediatrics 2013;131:S149-57.
6. Coon ER, Quinonez RA, Moyer VA, Schroeder AR. Overdiagnosis: how our compulsion for diagnosis may be harming children. Pediatrics 2014;134:1013-23.
7. Schmitt BD. Fever phobia: misconceptions of parents about fevers. Am J Dis Child 1980;134:176-81.
8. Datasets and Documentation: Centers for Disease Control and Prevention; 2020. Accessed September 6, 2018. https://www.cdc.gov/nchs/ahcd/datasets_documentation_related.htm
9. Scope and Sample Design: Centers for Disease Control and Prevention. Accessed September 1, 2020. https://www.cdc.gov/nchs/ahcd/ahcd_scope.htm
10. Estimation Procedures: Centers for Disease Control and Prevention. Accessed September 1, 2020. https://www.cdc.gov/nchs/ahcd/ahcd_estimation_procedures.htm
11. National Center for Health Statistics. Centers for Disease Control and Prevention. Accessed May 13, 2019. https://www.cdc.gov/nchs/ahcd/index.htm
12. Kroger AT, Strikas RA. Chapter 2: The Pretravel Consultation - General Recommendations for Vaccination & Immunoprophylaxis: Centers for Disease Control and Prevention; 2017 [updated June 1, 2019. June 13, 2017. Accessed May 1, 2019. https://wwwnc.cdc.gov/travel/yellowbook/2018/the-pre-travel-consultation/general-recommendations-for-vaccination-immunoprophylaxis
13. Evaluation and Management Services Guide. In: Department of Health and Human Services, Centers for Medicare and Medicaid Services; 2017. p. 55.
14. Compilation of The Social Security Laws: Definitions. Accessed November 18, 2020. https://www.ssa.gov/OP_Home/ssact/title19/1905.htm
15. Provider Billing Manual Appendix A: Well Child Check-Up (EPSDT) 2020. Accessed November 18, 2020. https://medicaid.alabama.gov/content/Gated/7.6.1G_Provider_Manuals/7.6.1.4G_Oct2020/Oct20_A.pdf
16. Moran CM, Panzarino VM, Darden PM, Reigart JR. Preventive services: blood pressure checks at well child visits. Clin Pediatr (Phila) 2003;42: 627-34.
17. Shapiro DJ, Hersh AL, Cabana MD, Sutherland SM, Patel AI. Hypertension screening during ambulatory pediatric visits in the United States, 2000-2009. Pediatrics 2012;130:604-10.
18. Hersh AL, Shapiro DJ, Pavia AT, Shah SS. Antibiotic prescribing in ambulatory pediatrics in the United States. Pediatrics 2011;128: 1053-61.
19. Gerber JS, Prasad PA, Localio AR, Fiks AG, Grundmeier RW, Bell LM, et al. Racial differences in antibiotic prescribing by primary care pediatricians. Pediatrics 2013;131:677-84.
20. Payne NR, Puumala SE. Racial disparities in ordering laboratory and radiology tests for pediatric patients in the emergency department. Pediatr Emerg Care 2013;29:598-606.
21. Shay S, Shapiro NL, Bhattacharyya N. Pediatric otolaryngologic conditions: racial and socioeconomic disparities in the United States. Laryngoscope 2017;127:746-52.
22. Garbutt J, Jeffe DB, Shackelford P. Diagnosis and treatment of acute otitis media: an assessment. Pediatrics 2003;112:143-9.