

# Drivers of High-cost Medical Complexity in a Medicaid Population

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**Background:** Efforts to improve outcomes for the 10% of patients using two thirds of health care expenditures increasingly include addressing social determinants. Empiric evidence is needed to identify the highest impact nonmedical drivers of medical complexity and cost.

**Objectives:** This study examines whether complex, highest cost patients have different patterns of critical life adversity than those with better health and lower utilization.

**Research Design:** Using a validated algorithm we constructed a complexity/cost risk patient profile. We developed and fielded a life experience survey (Supplemental Digital Content 1, <http://links.lww.com/MLR/B920>) to a representative sample, then examined how the prevalence of specific adversities varied between complex, high-cost individuals, and others.

**Subjects:** Surveys were sent to 9176 adult Medicaid members in Portland, Oregon.

**Measures:** Our primary variable was high medical complexity health cost risk; an alternative specification combined health cost risk and actual utilization/cost. Our survey instrument measured exposure to early and later-life adversities.

**Results:** Compared with healthy individuals in our population, medically complex individuals had significantly higher rates of adversity. The greatest risk of medical complexity and cost was associated with substance use [odds ratio (OR), 4.1], homelessness (OR, 3.0), childhood maltreatment (OR, 2.8), and incarceration (OR 2.4). Those with the highest prior year acute care utilization and cost had the highest rates of these same factors: substance use (62.5%), homelessness (61.7%), childhood maltreatment (55.5%), and incarceration (52.1%).

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**Conclusion:** Clinical and policy strategies that mitigate high-impact social drivers of poor outcomes are likely critical for improving both health and costs for complex, high-needs patients.

**Key Words:** life adversity, medical complexity, health care cost/ utilization

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With estimates that the most expensive decile of patients accounts for up to two thirds of total health care expenditures,<sup>1</sup> developing programs that improve outcomes for complex, high-cost patients has become an established national priority.<sup>2,3</sup> Many such programs focus on reducing expensive hospital and emergency department (ED) use through health system intensive care management. However, the challenge is increasingly recognized as more than medical—it is also about addressing social and behavioral issues that help generate costly intensive care needs.

Addressing nonmedical drivers of complex, high-cost health appears especially critical for low-income “high utilizers,” whose publically funded care includes higher rates of mental illness and substance use treatment, and who may be involved with the criminal justice, housing, or other human service systems.<sup>4</sup> The experiences of poverty and inequality have long been linked to poor health outcomes,<sup>5</sup> but a deeper understanding is needed of how specific life experiences are connected to poor health and high costs, and of upstream policies and programs that can potentially mitigate those linkages rather than face a continuing stream of complex, high-cost patients.

There is a strong precedent for such research. The Adverse Childhood Experiences (ACEs) study<sup>6</sup> and similar work has linked childhood challenges to later-life health impacts,<sup>7</sup> including heart, lung, or liver disease,<sup>8</sup> disease risk behaviors such as tobacco or injection drug use,<sup>6</sup> and to poor social outcomes including academic challenges,<sup>9</sup> financial and employment problems,<sup>10,11</sup> adult sexual victimization,<sup>12</sup> incarceration,<sup>10</sup> and homelessness,<sup>13</sup> which have in turn been associated with early mortality.<sup>14,15</sup> ACEs are particularly relevant to low-income communities, which have higher prevalence rates.<sup>16,17</sup>

However, ACEs are focused on traumas during early life and not on a broader view of exposure to adversity across the life course. The overall relationship between critical social adversities and high health care expenditures has yet to be empirically examined.

In this paper, we look at a generally high-risk Medicaid population to assess whether patients with the most complex,

high-cost health challenges have experienced different patterns of social adversity than those with lower health cost risks. We examine adversities across the life course, looking for pathways that may prove amenable to upstream interventions or systems and policy changes that could improve health outcomes and reduce the total costs of care.

## METHODS

### Study Population and Sampling

Our sampling universe included 134,088 adult members (age 18–65) of a regional Medicaid entity in Portland, Oregon in 2015; 106,146 met eligibility criteria of a valid mailing address and enrollment for at least 6 of the preceding 12 months. We drew a representative random sample of 9176 members, oversampling members in the highest decile of health cost risk and acute care (ED and inpatient) utilization (variables defined below) and for some race/ethnicity groups.

To address nonresponse bias, an intensive follow-up (IFU) arm of 2000 participants (22%) was drawn at the study start. This random subsample received all standard survey outreach. A sample of those not responding in this arm then received additional intensive telephone and door-to-door outreach to collect information from people who would otherwise have been nonresponders. Those who responded to the intensive outreach were up-weighted to “stand in” for nonrespondents generally using an approach outlined below and previously deployed in other research.<sup>18</sup>

### Weighting

We developed sampling weights to allow us to blend our sampling groups and estimate overall population prevalence. Within each sampling unit, the weight ( $W_i$ ) for each respondent is computed as follows:

$$W_i = w_{ij}f_{ik},$$

where  $w_{ij}$  is the individual's base weight, calculated as the reciprocal of the probability of inclusion of the individual  $i$  in sampling stratum  $j$ , and  $f_{ik}$  is an additional adjustment factor applied only to individuals who were in the IFU arm, did not respond to standard outreach, but responded to the more intensive outreach efforts. This adjustment factor is calculated as the reciprocal of the probability of being in the IFU arm; the final weight for individuals responding to the intensive outreach is the product of both weighting factors.

The additional IFU weight is applied only to individuals who would have been nonresponders in the absence of the IFU protocol. This helps address potential nonresponse bias: if, for example, nonresponders have a systematically higher prevalence than respondents in some attributes, we would tend to underestimate the actual prevalence of those attributes in the population. By collecting data from *some* nonresponders and then up-weighting those responses, we ensure that those attributes are no longer systematically under-represented, allowing for a better estimate of true population prevalence.

### Survey Development

We conducted in-depth interviews with 72 Medicaid members who met criteria for a complex care program to

identify key formative experiences within 5 age groupings: ages 0–5, 6–12, 13–18, 19–30, and over 30 years. We used these results to develop a survey instrument to capture experiences within key experience domains including relationships and support, safety and security, economic stability, trauma and adversity, substance use, criminal justice experiences, and others. We validated the survey instrument through a series of cognitive interviews with Medicaid members.

### Survey Fielding

Research has demonstrated that mixed-modal methods and incentives can increase response rates in Medicaid populations,<sup>19</sup> whereas lengthy surveys dealing with difficult content increase response burden and lower response rates.<sup>20</sup> We used multimodal methods, including 3 mail attempts paired with telephone reminder calls and a US\$5 stipend for participants. Respondents in the IFU arm also received personalized telephone and door-to-door follow-up.

### Response Rates

The unweighted survey response rate was 27%. Among those selected for IFU after initial nonresponse, 1 in 4 (25%) responded. After accounting for our IFU cases, our weighted response rate was 38%, which was calculated by multiplying each respondent by their final weight to define our total number of weighted population responses, then dividing that by the total population count. Our analytic dataset included 2344 respondents and our response rates are comparable with those achieved in other Medicaid survey studies.

### Key Measure #1: Health Complexity Cost Risk

To classify a member's health cost risk, we applied CDPS+Rx, the Medicaid risk adjustment methodology most widely used by States for setting payment rates with Managed Care Organizations. This validated claims-based algorithm scores members on the basis of medical conditions, demographics, prescriptions, and historical utilization and cost patterns. Higher CDPS+Rx scores represent members with complex health challenges and a significant probability of higher total costs over the subsequent year.<sup>21</sup>

We used CDPS+Rx scores to define 3 rank-ordered groupings. Our “high-cost risk” group includes individuals with CDPS+Rx scores in the top 10% of overall medical risk placing them in the highest decile of projected costs for the coming year. Our “medium cost risk” group includes members in the upper half of CDPS+Rx risk scores (51st–90th percentile), who often have chronic health challenges but do not project to be in the top 10% for cost. Finally, our “low-cost risk” group, comprising 50% of the Medicaid population, includes members with few or no complex conditions and CDPS+Rx scores in the bottom half (0%–50%) of the population distribution.

We structured our primary dependent variable around high health cost risk rather than actual accrued costs to focus on individuals likely to experience continuing or reoccurring high costs. A sporadic medical crisis may generate significant one-time costs, but research has shown that most of those who remain or are repeatedly in the top decile of costs over multiple years have high-risk medical

comorbidities,<sup>22,23</sup> such as those CDPS risk score is designed to capture.

### Key Measure #2: Cost Risk/Utilization Profile

Most complex care programs target individuals with both high-cost risk *and* acute care utilization (ED and inpatient). We, therefore, created an alternate specification that combines health cost risk and acute care utilization. We defined high acute care utilization as having  $\geq 2$  nonobstetrical inpatient admissions,  $\geq 3$  ED visits, or  $\geq 2$  ED visits and at least 1 inpatient admission in the prior year, the algorithm used by a local Medicaid initiative targeting most costly 10% acute care utilizers.<sup>24</sup> Using this definition, we created 4 mutually exclusive cost risk/utilization profile groups:

- (1) Complex high risk, high utilizers: individuals in the top 10% of both CDPS medical risk scores and acute care utilization.
- (2) Complex high risk, low utilizers: individuals in top 10% of CDPS medical risk scores, but not in the top 10% of acute care utilization.
- (3) Noncomplex low risk, high utilizers: individuals not in the top 10% of CDPS medical risk, but in the top 10% of acute care utilization.
- (4) Noncomplex low risk, low utilizers: individuals not in the top 10% of CDPS medical risk score or acute care utilization.

### Key Measure #3: Life Course Adversities

The exposure variables in our survey instrument included ACEs and maltreatment at any age, educational challenges, substance use, housing and employment instability, and criminal justice system involvement. We report binary outcomes within the specified time periods of the respondent's life.

### Other Measures

We also collected demographic data for our multivariate models, including age, sex, and race/ethnicity.

### Analytic Methods

We first conducted an exploratory descriptive analysis using 2-tailed  $\chi^2$  tests of association to assess whether each adverse life event's prevalence varied systematically across our 3 *cost risk* groups (high, medium, and low). We then used logistic regression to assess associations between each distinct adverse life experience and our health cost risk variable, adjusting for age, sex, and race/ethnicity. Our models took the stylized form:

$$y_i = \beta_0 + \beta_1 \text{EsVENT} + \beta_2 \text{AGE} + \beta_3 \text{GENDER} + \beta_4 \text{RACE},$$

...where  $y_i$  is the outcome of interest (health cost risks, with *medium* and *high* each tested in turn against the referent of *low*), event is a binary indicator of whether a given experience occurred, AGE is a continuous variable, GENDER is a binary variable, and RACE is a categorical variable with values of white non-Hispanic, Hispanic, black, Asian-American, and other. Because we were exploring a wide range of events, we adjusted for multiple comparisons by calculating

$P$ -values corrected for false discovery rate using the Benjamini-Hochberg procedure.<sup>25</sup>

All analyses were done using SAS version 9.4. This study was reviewed and approved by the Providence Portland Medical Center Institutional Review Board.

## RESULTS

Table 1 compares the demographic and health characteristics for our 3 health complexity cost risk groups. High health cost risk members had 8–10 fold higher rates of behavioral and physical comorbidities respectively than the lower cost risk groups. They were also older and more likely to be African American, variables adjusted for in our multivariate models.

Table 2 presents the weighted prevalence of adverse life experiences for the aggregate Medicaid population and for each of our 3 health cost risk groups. Overall, 42.1% of Medicaid members experienced  $\geq 4$  ACEs, with notably high rates of physical (39.6%), emotional (38.8%), and sexual (28.1%) abuse. Adversities beyond ACEs were also common, with 22.3% experiencing early family homelessness, 33.2% running away from home, and 28.2% using alcohol or illicit drugs at age 18 or younger. As adults, 39.6% struggled to find work; 33.3% experienced homelessness; and 25.6% experienced physical abuse from a loved one. Over a third report having substance use (34.3%) or having been jailed (35.6%).

Medicaid members in our high health cost risk group report the highest rates of nearly all adversities. Over half of these medically complex members (55.6%) had faced  $\geq 4$  ACEs, compared with 46.2% and 30.7%, respectively, in the medium or low groups ( $P=0.0002$ ). As adults, complex high-cost risk members are significantly more likely to have struggled with substance abuse (56.4% vs. 37.7% vs. 21.1%  $P=0.000$ ), housing instability (50.3% vs. 38.0 vs 19.5%,  $P=0.000$ ), physical abuse (37.2% vs. 27.0 vs. 19.5%,  $P=0.0008$ ), sexual abuse (24.3% vs. 18.5% vs. 8.7%,  $P=0.0002$ ), and emotional abuse (70.7% vs. 59.1% vs. 44.5%  $P=0.001$ ), and to have spent time in jail (48.0% vs. 40.7% vs. 22.9%,  $P < 0.0002$ ).

Table 3 examines the strength of association between reported adverse events and cost risk while adjusting for group differences in age, sex, and race/ethnicity. Members in the high health cost risk group had significantly increased odds ratio (OR, 2.8;  $P=0.0004$ ) of having histories of  $\geq 4$  ACEs compared with the lowest group. Beyond ACEs, they were also far more likely to have been adult substance users (OR, 4.1;  $P=0.0000$ ) or to have experienced housing instability in childhood (OR, 3.0;  $P < 0.0028$ ) or as an adult (OR, 3.5;  $P < 0.0003$ ). Overall, most of the adverse life events we measured showed significant graded associations with high health cost risks.

Finally, Table 4 examines the association between life course adversities and our alternate specification, which includes both cost risk and acute care utilization. Looking not just at cost risk but at actual utilization and associated cost, results show a strong graded relationship with exposure to adversity: members with both high health cost risk and high acute care utilization [ED 4.14/inpatient 1.03 per member per

**TABLE 1.** Demographic and Health Profile of Study Respondents

	Low Health Cost Risk % or Mean (n = 261)	Medium Health Cost Risk % or Mean (n = 1059)	High Health Cost Risk % or Mean (n = 1024)
% Total sample	33.0	55.9	11.1
Demographic profile			
Sex: male	43.1	32.8	41.4
Age, mean	37.7	44.0	50.0
White	75.4	73.3	76.3
Black	6.1	10.6	11.2
Hispanic	7.1	14.8	7.8
Asian	9.5	4.9	2.8
Hawaiian/Pacific Islander	2.1	0.2	1.2
Native American	2.5	8.1	6.4
Other or unknown	6.2	8.5	7.0
Health profile			
Mean # physical health conditions	0.8	4.7	8.2
Mean # behavioral health conditions	0.3	2.0	2.4
With chronic mental health condition			
Bipolar disorder	0.8	9.7	14.6
Anxiety disorder	17.9	32.5	43.7
Depression and depressive disorders	19.0	40.0	50.8
Schizophrenia/psychosis	1.9	10.1	16.7
With chronic physical condition			
Asthma, COPD, chronic lung disease	3.4	19.3	39.8
Chronic liver disease including hepatitis	0.8	5.5	21.3
Congestive heart failure	n/a	1.0	11.2
Hypertension	10.1	30.5	50.5
Diabetes mellitus	0.4	11.7	30.9

Results are weighted to account for sampling design.  
COPD indicates chronic obstructive pulmonary disease.

year (PMPY)] have significantly higher prevalence of life adversities than members with low health cost risk and low utilization (ED 0.29/inpatient 0.07 PMPY), particularly in substance use (62.5% vs. 35.8%,  $P < 0.001$ ), homelessness (61.7% vs. 38.2%,  $P < 0.001$ ), and incarceration (52.1% vs. 33.8%,  $P = 0.001$ ); they also had a 20-fold difference in yearly costs (US\$48,876 vs. US\$2,568). High cost risk members who do not use acute care services have somewhat lower levels of these adversities, particularly homelessness (46.6%), but also relatively high yearly costs (US\$13,248). Both high cost and low cost risk acute care utilizers have the highest burdens of early life adversity ( $ACE \geq 4 = 55\%$ ) and overall higher subsequent challenges, but the lower cost risk groups' utilization is mainly lower cost ED visits (3.55 PMPY). Across all significant data points, the lowest adversity levels are in the low cost risk, low acute care group.

### DISCUSSION

This study explores associations between life course social adversity and the risk of high medical costs or acute care utilization. We examined a Medicaid population who experienced multiple stressful life events, often starting in childhood: 42.1% had  $\geq 4$  ACEs, higher than the national rate of 14.3%. Only 1 in 5 (20.7%) had no ACEs, compared with 40.7% nationally.<sup>7</sup>

We found strong confirmation of the relationship between early adversities and adult morbidity: complex high-cost risk Medicaid members were most likely to have experienced  $\geq 4$  ACEs (55.6%, OR, 2.80 relative to low-risk members).

However, ACEs were not the entire story. Compared with low-risk members, the high-risk group also had twice the rate of family homelessness and nearly twice the rate of childhood substance abuse. As adults, they had twice the rate of homelessness, substance abuse, and incarceration, and almost 3 times the rate of adult sexual abuse. Nearly every adverse life experience studied was far more prevalent among our high-cost risk group than among low-cost risk Medicaid members.

We also examined health cost risk in relation to acute care utilization, as intervention programs generally target individuals with frequent ED or inpatient care. We found that medically high-risk individuals with high rates of costly acute care were far more likely to have experienced almost every type of adversity we measured, both in childhood and adulthood. Given that these individuals had very high total costs of care in their prior year (averaging US\$48,876) and have risk scores predicting continued high costs, the clear graded relationship between social adversity, cost, and utilization strongly suggest that strategies for addressing such nonmedical risk factors will be key to bending the cost curve. Though estimating potential cost savings was beyond the scope of this study, the magnitude of differences at play confirms the importance of addressing the drivers of medical complexity and high costs—our complex high utilizer group had US\$35,000 per year more in average per-person expenditures than the complex nonhigh utilizer group.

Programmatically, our findings indicate a need for complex care initiatives to be trauma-informed and to address trauma recovery,<sup>3</sup> particularly in communities experiencing poverty and inequality. More broadly, our study identifies at

least 4 specific upstream pathways that set the stage for poor health and high utilization that successful strategies for reducing complex care costs will likely need to address:

### Substance Use

Adult substance use is more strongly associated with high-cost risk than any other life experience in our study (OR, 4.1), being reported by over 60% of the highest cost group. We also found a high prevalence of early life substance use in that group, which substantially increases the risk of subsequent addiction.<sup>26</sup> Although promoting long-term recovery for this chronic brain disease with high relapse rates<sup>27</sup> seems critical, substance use disorder treatment remains largely separate from the larger health care system, and treats only 10% of those in need.<sup>28</sup> Our study suggests that the success of complex care strategies will depend upon a commitment to addiction treatment system transformation, including overcoming structural issues impeding integration, a shortage of evidence-based care, and substantial resource gaps.<sup>29</sup>

### Homelessness

Over 60% of our medically complex, high cost group experienced homelessness, with over 30% experiencing

childhood homelessness. The importance of housing as health care is increasingly recognized. Medicaid now reimburses more housing-related services than before the Affordable Care Act and a growing number of initiatives provide cross-sector supports.<sup>30,31</sup> Experts in the field advocate that housing is a “hub” for personal and social wellbeing and should be a hub for health and community services.<sup>32</sup> Engaging with housing initiatives may be one of the most effective ways for complex care programs to impact the lived realities driving poor health outcomes in their communities.

### Corrections

Over half of our medically complex, highest cost Medicaid members reported having been in jail. Other recent studies have demonstrated a strong correlation between Medicaid high utilization, incarceration,<sup>4</sup> and arrests.<sup>33</sup> Multiple national efforts centered on community criminal justice systems are focusing on frequent users cycling through both health care and corrections.<sup>34</sup> Many multisystem users have been found to also have substance use disorders<sup>35</sup> and/or co-occurring mental health conditions.<sup>36</sup> A key component of complex care success will likely include workflow integrations across sectors and policy efforts that help improve

**TABLE 2.** Unadjusted Prevalence of Adversity Experiences by Medical Complexity/Cost Group

	Total Medicaid N (%)	Low Health Cost Risk (Lowest 50%)		Medium Health Cost Risk (51%-90%)		High Health Cost Risk (Highest 10%)		P		
		N (%)	N (%)	95% CI	N (%)	95% CI	N (%)	95% CI	Unadjusted	Corrected*
<b>ACE-related adversity</b>										
No ACEs	377 (20.7)	76 (28.8)	21–36.6	144 (16.7)	11.7–21.7	157 (16.8)	12.4–21.2	0.02	<b>0.0260</b>	
≥ 4 ACEs	1145 (42.1)	80 (30.7)	22.3–39.1	542 (46.2)	39.5–52.9	523 (55.6)	49–62.2	0.0001	<b>0.0002</b>	
Physical abuse	1003 (39.6)	69 (26.3)	18.3–34.3	468 (45.4)	38.7–52.1	466 (50.1)	43.0–57.3	<0.0001	<b>0.0002</b>	
Emotional abuse	1025 (38.8)	74 (26.7)	19–34.3	479 (43.7)	37–50.3	472 (51.0)	44.0–58.1	<0.0001	<b>0.0002</b>	
Sexual abuse	828 (28.1)	48 (16.9)	10.5–23.3	384 (32.9)	26.5–39.2	396 (37.2)	31.1–43.3	<0.0001	<b>0.0001</b>	
Physical neglect	1139 (45.2)	93 (33.2)	25–41.4	551 (50.7)	44–57.4	495 (53.4)	46.5–60.2	0.0009	<b>0.0014</b>	
Emotional neglect	564 (22.1)	36 (16.1)	9.2–22.9	270 (25.1)	19.4–30.7	258 (25.3)	20.1–30.5	0.07	0.0888	
Witnessed domestic violence	777 (27.1)	57 (17.7)	12–23.5	368 (31.4)	25.2–37.6	352 (33.6)	27.7–39.4	0.0004	<b>0.0008</b>	
Parent with SU disorder	1068 (39.1)	78 (26.3)	18.9–33.7	503 (45.8)	39–52.6	487 (44.2)	37.5–50.8	0.0003	<b>0.0007</b>	
Parent with MH disorder	885 (38.1)	72 (33.1)	24.2–42	424 (40.3)	33.6–46.9	389 (42.0)	34.1–49.8	0.31	0.3168	
Parent went to prison	473 (20.5)	35 (14.3)	7.6–21	243 (24.2)	17.9–30.5	195 (20.9)	16.1–25.8	0.10	0.1164	
Parents divorced	1038 (49.0)	101 (43.5)	34.2–52.8	473 (52.9)	45.7–59.9	464 (47.2)	39.8–54.6	0.27	0.2922	
<b>Other adversity</b>										
Struggled with schoolwork	1349 (53.3)	114 (42.4)	33.7–51.1	634 (57.9)	51.4–64.5	601 (61.9)	55.8–68.0	0.002	<b>0.0030</b>	
Did not graduate high school	692 (27.2)	45 (20.8)	12.9–28.8	350 (30.5)	24.2–36.8	297 (29.2)	23.7–34.7	0.14	0.1566	
Ran away from home	903 (33.2)	53 (15.7)	10.3–21.2	435 (42.1)	35.3–48.9	415 (40.6)	34.1–47.0	<0.0001	<b>0.0000</b>	
Substance abuse as a child	788 (28.2)	48 (19.4)	12.4–26.4	360 (31.8)	25.4–38.2	380 (36.8)	32.1–41.5	0.0003	<b>0.0006</b>	
Substance abuse as adult	1043 (34.3)	59 (21.1)	14.4–27.9	458 (37.7)	31.1–44.2	526 (56.4)	49.8–63.1	<0.0001	<b>0.0000</b>	
Substance abuse ever	1159 (38.9)	74 (26.4)	19–33.8	514 (42.3)	35.6–48.9	571 (58.8)	52.5–65.2	<0.0001	<b>0.0000</b>	
Homelessness as child	552 (22.3)	31 (10.6)	5.6–15.5	276 (28.7)	22.1–35.4	245 (24.9)	19.8–29.9	<0.0001	<b>0.0001</b>	
Homelessness as an adult	951 (33.3)	51 (19.5)	12.3–26.6	454 (38.0)	31.3–44.7	446 (50.3)	42.9–57.6	<0.0001	<b>0.0000</b>	
Homelessness ever	1124 (40.8)	69 (24.8)	17.2–32.4	541 (47.4)	40.7–54.1	514 (54.6)	47.9–61.3	<0.0001	<b>0.0000</b>	
Struggled to find work	1040 (39.6)	89 (38.3)	29.3–47.3	496 (40.3)	33.7–46.8	455 (40.2)	33.9–46.6	0.93	0.9305	
Adult physical abuse	770 (25.6)	52 (19.5)	12.4–26.6	344 (27.0)	21.0–33.0	374 (37.2)	30.9–43.5	0.0005	<b>0.0008</b>	
Adult sexual abuse	553 (15.9)	17 (8.7)	3.0–14.3	260 (18.5)	13.6–23.5	276 (24.3)	19.5–29.0	0.0001	<b>0.0002</b>	
Adult emotional abuse	1423 (55.6)	120 (44.5)	35.5–53.4	637 (59.1)	52.6–65.6	666 (70.7)	65.4–76.0	<0.0001	<b>0.0001</b>	
Went to jail	984 (35.6)	53 (22.9)	14.8–31.1	458 (40.7)	34.0–47.5	473 (48.0)	40.6–55.4	<0.0001	<b>0.0002</b>	
Went to prison	199 (4.2)	6 (2.48)	0.3–4.7	81 (4.4)	1.8–6.9	112 (8.8)	6.1–11.4	0.001	<b>0.0014</b>	

Bold indicates statistical significance (\*P < 0.05 or less) for 2-tailed  $\chi^2$  test of association using FDR-corrected P-values.

Results are weighted to account for sampling design.

\*P-values were corrected using the FDR method to account for multiple testing.

ACE, adverse childhood experience; CI, confidence interval; FDR, false discovery rate; MH, mental health; SU, substance use.

**TABLE 3.** Adjusted Associations Between Adverse Experience History and Medical Complexity/Cost as an Adult

	Overall	Medium Cost Risk (vs Low)				High-Cost Risk (vs Low)			
	Prevalence (%)	OR	95% CI	P	Corrected P*	OR	95% CI	P	Corrected P*
ACE-related adversity									
Reported no ACEs	20.7	0.5	0.28–0.83	0.0089	<b>0.0133</b>	0.5	0.26–0.81	0.0069	<b>0.0075</b>
Reported ≥ 4 ACEs	42.1	1.9	1.15–3.12	0.0120	<b>0.0169</b>	2.8	1.64–4.77	0.0002	<b>0.0004</b>
Physical abuse	39.6	2.4	1.40–4.00	0.0012	<b>0.0055</b>	2.9	1.64–5.11	0.0002	<b>0.0006</b>
Emotional abuse	38.8	2.0	1.24–3.31	0.0048	<b>0.0114</b>	2.6	1.55–4.48	0.0004	<b>0.0008</b>
Sexual abuse	28.1	2.0	1.14–3.66	0.0162	<b>0.0204</b>	2.7	1.50–4.70	0.0008	<b>0.0016</b>
Physical neglect	45.2	1.9	1.17–3.02	0.0086	<b>0.0138</b>	2.1	1.26–3.55	0.0046	<b>0.0071</b>
Emotional neglect	22.1	1.5	0.79–2.77	0.2166	0.2397	1.5	0.76–2.73	0.2561	0.2724
Witnessed domestic violence	27.1	2.0	1.20–3.42	0.0078	<b>0.0138</b>	2.3	1.38–3.95	0.0016	<b>0.0030</b>
Parent with SU disorder	39.1	2.2	1.38–3.59	0.0010	<b>0.0049</b>	2.0	1.23–3.34	0.0055	<b>0.0068</b>
Parent With MH disorder	38.1	1.5	0.89–2.50	0.1276	0.1437	1.5	0.86–2.69	0.1510	0.1654
Parent who went to prison	20.5	2.0	1.03–4.01	0.0407	<b>0.0447</b>	2.2	1.08–4.32	0.0302	<b>0.0339</b>
Parents divorced	49.0	1.5	0.92–2.47	0.1041	0.1098	1.2	0.72–2.09	0.4515	0.4486
Other adversity									
Struggled with schoolwork	53.3	2.0	1.23–3.12	0.0043	<b>0.0106</b>	2.3	1.41–3.70	0.0008	<b>0.0016</b>
Did Not graduate high school	27.2	1.4	0.81–2.51	0.2249	0.2403	1.2	0.69–2.14	0.5035	0.4926
Substance abuse in childhood	28.2	1.9	1.12–3.37	0.0185	<b>0.0276</b>	2.2	1.28–3.74	0.0041	<b>0.0070</b>
Substance abuse as adult	34.3	2.3	1.38–3.96	0.0015	<b>0.0060</b>	4.1	2.44–6.99	<0.0001	<b>0.0000</b>
Substance abuse ever	38.9	2.1	1.25–3.35	0.0044	<b>0.0108</b>	3.3	2.03–5.47	<0.0001	<b>0.0000</b>
Homeless/housing instability as child	22.3	3.6	1.82–6.99	0.0002	<b>0.0014</b>	3.0	1.54–6.01	0.0014	<b>0.0028</b>
Homeless/housing instability adult	33.3	2.5	1.40–4.42	0.0020	<b>0.0063</b>	3.5	1.92–6.49	<0.0001	<b>0.0003</b>
Homeless ever	40.8	2.7	1.59–4.48	0.0002	<b>0.0020</b>	3.2	1.84–5.51	<0.0001	<b>0.0003</b>
Ran away from home	33.2	3.5	2.05–6.03	<0.0001	<b>0.0001</b>	3.1	1.76–5.50	0.0001	<b>0.0004</b>
Struggled to find work	39.6	1.2	0.71–1.89	0.5540	0.5015	1.2	0.73–2.03	0.4615	0.4498
Adult physical abuse	25.6	1.2	0.67–2.17	0.5254	0.4599	2.2	1.21–3.91	0.0090	<b>0.0099</b>
Adult sexual abuse	15.9	2.1	0.91–4.80	0.0812	0.1046	3.0	1.32–6.64	0.0082	<b>0.0106</b>
Adult emotional abuse	55.6	1.8	1.10–2.85	0.0179	<b>0.0216</b>	2.7	1.63–4.61	0.0001	<b>0.0004</b>
Went to jail	35.6	2.4	1.29–4.34	0.0052	<b>0.0103</b>	2.4	1.29–4.26	0.0051	<b>0.0069</b>
Went to prison	4.2	1.7	0.51–5.39	0.4026	0.3875	2.2	0.72–6.52	0.1683	0.1790

Bold indicates statistical significance (\*P < 0.05 or less) for the associated OR versus referent group using FDR-corrected P-values.

Results are weighted to account for sampling design.

Models adjusted for age, sex, race, and ethnicity.

Each adverse experience is a distinct regression model.

\*P-values were corrected using the FDR method to account for multiple testing.

ACE, adverse childhood experience; CI, confidence interval; FDR, false discovery rate; MH, mental health; OR, odds ratio; SU, substance use.

diversion to treatment, jail health care, jail to community transition and reintegration, and data sharing.

### Life Course Interpersonal Adversity

Strong associations between adverse experiences and later health morbidity are well established. Our study finds a similar association between ACEs and high health care costs, suggesting that complex care strategies could usefully move upstream by focusing on children and families at risk. A “return on investment” for early life interventions, long argued by those researching ACEs,<sup>37,38</sup> seems even more compelling once the link is made between adverse childhood events, subsequent health and social morbidity, and cost outcomes, especially for the segment of the population who account for up to two thirds of all health care expenditures. Clinical practice models that address early toxic stress exist and have been highlighted in previous work.<sup>39</sup> There is also increasing interest in addressing ACEs and risk in both parents and children in pediatric practices.<sup>40,41</sup> Our study also found other types of interpersonal adversity associated with high-cost risk; for example, the high prevalence of adult interpersonal violence may support including screening and intervention

for interpersonal in complex care models for this population.<sup>42,43</sup> Our data suggest the need for a comprehensive, longitudinal, multigenerational strategy for addressing life trauma as a driver of the health care cost crisis.

Overall, our study supports reconceptualizing complex care and the challenge of high-cost patients not just as a problem of enhanced case management, but as a population strategy predicated on addressing the key social risks that “set the stage” for individuals to become complex, high-cost patients. Many of the first steps in this shift have begun, and the opportunity may lie in aligning and supporting efforts to bridge work across health care, addictions treatment, housing, criminal justice, and other sectors. The biggest challenge in doing so maybe that regulatory infrastructures were not designed to support cross-sector collaboration, but this is an area where policymakers may be well-positioned to take supportive action.

Our study has several key limitations. First, it is unlikely that our survey captured all the defining adversities of each individual’s life. Our study also does not assess the frequency, duration, or intensity of the types of experiences reported within a given time period, nor does it examine the

**TABLE 4.** Unadjusted Prevalence of Adversity Experiences by Medical Complexity and Utilization Group

Weighted Mean Total Cost/Utilization PMPY	Non-High Complexity, N (%)		High Complexity, N (%)		Corrected P*
	Non-High Acute Care Utilizer	High Acute Care Utilizer	Non-High Acute Care Utilizer	High Acute Care Utilizer	
	Year Cost: US\$2,568 ED Visits: 0.29 INPT Admits: 0.07	Year Cost: US\$9,240 ED Visits: 3.55 INPT Admits: 0.26	Year Cost: US\$13,248 ED Visits: 0.72 INPT Admits: 0.32	Year Cost: US\$48,876 ED Visits: 4.14 INPT Admits: 1.03	
ACE-related adversity					
No ACEs	137 (21.9)	47 (12.9)	130 (18.5)	63 (11.5)	0.005
≥ 4 ACEs	240 (39.7)	249 (55.0)	385 (50.7)	271 (55.5)	<b>0.001</b>
Physical abuse	222 (38.2)	194 (42.9)	348 (46.6)	239 (47.7)	0.113
Emotional abuse	232 (37)	202 (44.2)	350 (48.0)	241 (48.9)	0.020
Sexual abuse	159 (25.9)	178 (39.8)	284 (35.7)	207 (41.8)	< <b>0.001</b>
Physical neglect	261 (43.4)	247 (60.0)	373 (49.6)	258 (52.5)	0.007
Emotional neglect	141 (21.8)	106 (21.9)	198 (25.3)	119 (23.0)	0.713
Witnessed domestic violence	160 (24.9)	184 (44.3)	245 (32.2)	188 (39.0)	< <b>0.001</b>
Parent with SU disorder	225 (36.9)	225 (53.4)	366 (44.9)	252 (53.7)	< <b>0.001</b>
Parent with MH disorder	208 (37.6)	180 (40.8)	291 (39.1)	206 (42.0)	0.758
Parent went to prison	109 (20.1)	112 (24.9)	139 (19.7)	113 (26.3)	0.208
Parents divorced	253 (48.3)	206 (54.6)	340 (48.9)	239 (55.8)	0.244
Other adversity					
Struggled with schoolwork	300 (51.4)	292 (69.0)	450 (57.6)	307 (61.5)	<b>0.002</b>
Did not graduate high school	160 (26.1)	162 (36.9)	218 (29.3)	152 (32.2)	0.107
Ran away from home	185 (31)	194 (47.7)	306 (40.3)	218 (45.5)	<b>0.001</b>
Substance abuse as a child	154 (26.5)	162 (34.1)	273 (35.1)	199 (40.1)	0.014
Substance abuse as adult	197 (31.2)	206 (41.9)	360 (48.5)	280 (59.8)	< <b>0.001</b>
Substance abuse ever	226 (35.8)	229 (47.7)	404 (51.8)	300 (62.5)	< <b>0.001</b>
Homelessness as child	118 (21.4)	120 (26.7)	175 (24.4)	139 (32.0)	0.095
Homelessness as an adult	174 (30.3)	205 (50.8)	305 (40.8)	267 (55.9)	< <b>0.001</b>
Homelessness ever	226 (38.2)	242 (56.2)	359 (46.6)	297 (61.7)	< <b>0.001</b>
Struggled to find work	234 (38)	225 (50.8)	322 (41.3)	259 (53.1)	<b>0.002</b>
Adult physical abuse	140 (22.7)	164 (41.7)	239 (32.6)	227 (50.4)	< <b>0.001</b>
Adult sexual abuse	91 (13.6)	119 (27.9)	189 (22.0)	154 (33.1)	< <b>0.001</b>
Adult emotional abuse	318 (53.6)	285 (65.0)	479 (62.9)	341 (69.0)	0.005
Went to jail	189 (33.8)	209 (43.2)	314 (40.9)	272 (52.1)	<b>0.001</b>
Went to prison	25 (3.2)	40 (7.4)	72 (9.7)	62 (9.8)	< <b>0.001</b>

Bold indicates statistical significance (\*P < 0.05 or less) for 2-tailed  $\chi^2$  test of association using FDR-corrected P-values.

Results are weighted to account for sampling design.

\*P-values were corrected using the FDR method to account for multiple testing.

ACE, adverse childhood experience; FDR, false discovery rate; INPT, inpatient; MH, mental health; OR, odds ratio; PMPY, per member per year; SU, substance use.

interaction between adversity and membership in social categories such as racial, ethnic, or cultural communities. Finally, despite our IFU efforts, the low overall response rate to our survey (38%) means that our findings may not be representative of the Medicaid population as a whole. However, our primary study objective was to compare the prevalence of adverse events across our health complexity/cost groups, and as response rates were roughly equivalent across those groups, comparisons between them should be unbiased even if our overall prevalence estimates are subject to nonresponse bias.

Our study raises significant questions for future research. Do adverse events create specific cascades where 1 adversity increases the probability of another, magnifying risk? Are these “pathways” of adversity predictable and subject to intervention, and community-specific? And to what extent are such pathways the result of institutional biases, policies, system fragmentation, or misaligned interests that policy efforts could address?

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