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Variation in Nevada primary care clinicians' use of urine drug testing to mitigate opioid harm

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ABSTRACT

Introduction: The prescription opioid epidemic led to federal, state, and health system guidelines and policies aimed at mitigating opioid misuse, including presumptive urine drug testing (UDT). This study identifies whether a difference exists in UDT use among different primary care medical license types.
Methods: The study used January 2017–April 2018 Nevada Medicaid pharmacy and professional claims data to examine presumptive UDTs. We examined correlations between UDTs and clinician characteristics (medical license type, urban/rural status, care setting) along with clinician-level measures of patient mix characteristics (proportions of patients with behavioral health diagnoses, early refills). Adjusted odds ratios (AORs) and predicted probabilities (PPs) from a logistic regression with a binomial distribution are reported. The analysis included 677 primary care clinicians (medical doctors [MD], physician assistants [PA], nurse practitioners [NP]).
Results: Of those in the study, 85.1 % of clinicians did not order any presumptive UDTs. NPs had the highest proportion of UDT use (21.2 % of NPs), followed by PAs (20.0 % of PAs), and MDs (11.4 % of MDs). Adjusted analyses showed that being a PA or NP was associated with higher odds of UDT (PA: AOR: 3.6; 95 % CI: 3.1–4.1; NP: AOR: 2.5; 95 % CI: 2.2–2.8) compared to being an MD. PAs had the highest PP for ordering UDTs (2.1 %, 95 % CI: 0.5 %–8.4 %). Among clinicians who ordered UDTs, midlevel clinicians had higher mean and median UDT use (PA and NP mean: 24.3 % vs. MDs: 19.4 %; PA and NP median: 17.7 % vs. MDs: 12.5 %).
Conclusion: In Nevada Medicaid, UDTs are concentrated among 15 % of primary care clinicians who are frequently non-MDs. More research should include PAs and NPs when examining clinician variation in mitigating opioid misuse.

1. Introduction

A national survey in 2015 estimated that 12 % of noninstitutionalized adults with opioid prescriptions misused opioids (Han et al., 2017). The use of urine drug testing (UDT) has been recommended as one strategy to mitigate risk of opioid misuse in Centers for Disease Control and Prevention (CDC) guidelines and by professional associations such as the American Society of Interventional Pain Physicians and the American Academy of Pain Medicine (Dowell et al., 2016; Jannetto et al., 2018; Manchikanti et al., 2012; Nuckols et al., 2014).

Currently, the CDC's 2016 guideline for pain care in primary care recommends initial UDTs for opioid naïve patients (i.e., patients without a recent history of opioid use) and annual UDTs for long-term opioid prescribed patients (Centers for Disease Control and Prevention (CDC), 2021). Universal application of the guidelines (i.e., routine use for all patients) has the potential to be beneficial. UDTs can inform clinicians about whether patients are not taking (and thus potentially diverting) prescription opioids or taking other nonprescribed controlled substances (Canada et al., 2014). Clinicians can then use this information to enhance discussions with patients on the harms and benefits of opioid use (Pergolizzi et al., 2010). Research has shown that UDTs used in conjunction with patient education increase patient compliance in proper use of opioids (Knezevic et al., 2017).

Despite increases in the use of UDTs for long-term opioid users (Taha et al., 2021), administration of UDTs remains far from universal (Friedman et al., 2020; Larochelle et al., 2017; Starrels et al., 2011).

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However, we know little about primary-care clinician-level variation in presumptive UDT use (i.e., screening tools). For example, patient-level analyses could mask the existence of some providers using UDTs for a high proportion of their opioid-prescribed patients. Identifying which types of providers are incorporating UDTs into their care of opioid prescribed patients (or are more likely to use them) and providers who are not incorporating UDTs may inform educational efforts to increase uptake of this recommended practice.

The CDC recommendations on UDTs target primary care clinicians, which includes midlevel clinicians such as physicians assistants (PAs) and nurse practitioners (NPs), as well as medical doctors (MDs) practicing primary care. Evidence suggests that midlevel clinicians prescribe higher opioid doses (Cron et al., 2020; Ellenbogen & Segal, 2020; Lozada et al., 2020) and have higher frequency of prescribing opioids compared to MDs (Lozada et al., 2020). These findings might suggest that midlevel clinicians have more opportunities to conduct UDTs and thus use them more frequently, on average, compared to MDs; although, as of yet, this has not been studied. As midlevel clinicians are increasingly providing primary care (Streeter et al., 2017), understanding their UDT use is salient.

Many, but not all, states in the United States allow PAs and NPs to prescribe opioids. Six states restrict or do not allow PAs to prescribe opioids, while 7 states restrict or do not allow NPs to prescribe opioids (Drug Enforcement Agency, 2022). Nevada provides a setting in which we can compare presumptive UDT use for opioid-prescribed patients across medical license types, since Nevada law allows PAs and NPs to prescribe Schedule II opioids (NRS: 639.1373, n.d.; Med Source Consultants, 2018).

Indeed, the current study investigates differences between MDs and midlevel clinicians in presumptive UDT use among opioid-prescribed Medicaid patients in Nevada. Both the focus on primary care clinicians and the study's goal to determine provider-specific traits associated with requiring UDTs for patients align with the CDC guideline to conduct a UDT upon writing an opioid prescription for pain care in a primary care setting (Dowell et al., 2016). This study adds to the existing literature by examining differences in medical license types associated with presumptive UDT use, as no studies exist to the authors' knowledge that examine this. The following analysis answers the central question: Is there a difference in medical license types, clinician setting, and clinician location in the use of presumptive UDTs?

2. Material and methods

2.1. Data

This study uses Medicaid outpatient professional and pharmacy claims data (January 1, 2017, through April 30, 2018) provided by the Nevada Department of Healthcare Financing and Policy. The outpatient claims data included clinician identifiers, service dates, procedure codes, de-identified patient identifiers, claim place of service, and diagnoses codes. The pharmacy claims data included prescribing clinician identification, prescription fill dates, national drug codes, days' supply, and de-identified patient identifiers. The University of Nevada, Reno Institutional Review Board reviewed this study and deemed it exempt.

2.2. Study sample

To identify the study sample, we identified clinicians (based on unique national provider identifiers; NPIs) associated with filled opioid prescriptions in the pharmacy claims data and who were present in the outpatient professional claims data (N = 2422 clinicians). For MDs, the study determined primary care status by specialty type (family practice, general practice, geriatrics, and internal medicine). For PAs and NPs, the study determined primary care status when at least 50 % of all professional claims could be characterized as primary care–oriented evaluation and management procedure codes. We used procedure codes to identify PA and NP primary care clinicians because the claims data did not indicate specialty for them. This process identified 1798 primary care clinicians.

Additional sample inclusion required nonmissing place of service in an outpatient setting, including office, special outpatient setting (i.e., federally qualified health center and rural health clinic), and urgent care facility (n = 1063), and a Nevada address linked to the provider's NPI. This resulted in 677 sample clinicians associated with 33,505 Medicaid opioid-prescribed patients.

Notably, a sensitivity analysis did not exclude clinicians missing addresses from the analysis (n = 1063). See Appendix A for a flowsheet detailing the creation of the study sample.

2.3. Outcome variable

The outcome was primary care clinicians' presumptive UDT rates (hereafter called “UDT” for simplicity). To measure UDT, we used current procedural terminology (CPT) codes 80,305, 80,306, and 80,307. These CPT codes are used to bill the procedures a clinician performs during a patient visit and differ based on the level of complexity of the UDT used during the patient visit (80,305 is the least complex test and 80,307 is the most complex). The level of complexity is based on the testing methodology used for the UDT: for 80,305, the UDT is read by direct observation; for 80,306, it is read by instrument-assisted observation; and for 80,307, it is read by instrument chemistry analyzers, chromatography, and mass spectrometry.

We calculated UDT rates for each clinician in the study sample. We divided the number of patients with at least one UDT used by the provider during the study period by the number of patients the provider prescribed opioids to during the study period.

An individual patient can have UDTs conducted by multiple clinicians. When that happens, that individual would be included in the numerator for all the relevant clinicians. Similarly, an individual patient may have prescriptions written by multiple clinicians. When that happens, that individual would be included in the denominator of all the relevant clinicians.

2.4. Clinician-level characteristics

The primary care clinician-level predictors included clinician medical license type, clinician setting, and clinician location. The clinician medical license type variable had the following categories: PAs, NPs, and MDs; all the clinician medical license types have prescriptive authority for Schedule II medications. The clinician setting variable had the following categories: office, special outpatient settings (rural health clinic and federally qualified health center), and urgent care. Clinician location classified clinicians as urban, rural, or frontier based on their practice zip code. All clinician medical license type and place of service categories were mutually exclusive.

2.5. Patient-mix characteristics aggregated to the clinician level

We adapted patient-level predictors from an earlier study of UDT use (Friedman et al., 2020). We identified individuals with diagnoses that have been associated with indicators (i.e., diagnosis of opioid use disorder) or risk factors (behavioral health diagnoses and early refills) of opioid misuse (Ives et al., 2006; Pergolizzi et al., 2012; Sullivan et al., 2010; Turk et al., 2008). In total, the study found five predictor variables quantifying, for each primary care clinician, the percentage of opioid-prescribed patients diagnosed with: (1) opioid use disorder (OUD); (2) mental health conditions (MH; bipolar disorder, post-traumatic stress disorder, general anxiety disorder, depression), (3) alcohol-related disorder (AD); (4) other substance abuse disorder (OSAD; cannabis-related disorder, cocaine-related disorder, other stimulant related disorder); or (5) nicotine disorder (ND; nicotine dependence disorder, tobacco use). An additional predictor variable quantified the percentage of opioid

prescribed patients with an early refill (defined as a refill obtained while previous prescription had 15 days' supply remaining), which could signify potential misuse (i.e., taking more than prescribed). We also constructed an indicator of the existence of two or more of the behavioral health opioid misuse risk factors described above for use in a sensitivity analysis. See Appendix B for the diagnosis codes used to create patient-diagnosis variables.

2.6. Analyses

We determined frequencies, means, and standard deviations for the outcome, UDT rates, and predictors. Additionally, we compared the mean and median of UDT rates among providers with at least one UDT using *t*-test and Wilcoxon Rank Test. We modeled associations of primary care clinician UDT rates with potential clinician-level sources of UDT rate variation using logistic regressions with a binomial distribution. From the logistic regressions, we estimated and reported the adjusted odds ratios (AOR) and the predicted probabilities for all predictors. The predicted probabilities indicate the probability that a primary care clinician with a specific characteristic used a UDT, setting all other predictors to zero.

We also conducted the following four sensitivity analyses: (1) conducted the main analysis among primary care clinicians regardless of missing city location (n = 1326 clinicians); (2) controlled for two or more opioid misuse risk factors; (3) used an alternative outcome measure: total volume of UDT claims as the proportion of opioid-prescribed patients; and (4) calculated the predicted probabilities among primary care clinicians with consistent clinician setting listed for 50 % or more of their claims (n = 502). We used SAS version 9.4 software (SAS Institute Inc., Cary, NC, USA) to analyze the data.

3. Results

3.1. Unadjusted presumptive UDT rates

The 677-primary care clinician sample consisted of 412 MDs, 105 PAs, and 156 NPs. The study found, on average, 35 opioid prescribed patients per MDs (SD: 44.6), 122 opioid prescribed patients per PA (SD: 237.9), and 77 opioid prescribed patients per NP (SD: 161.5; data not in table).

Most sample clinicians (85.1 %) did not use UDTs during our study period. NPs had the highest proportion of UDT use (21.2 % of NPs), followed by PAs (20.0 % of PAs), and MDs (11.4 % of MDs; percentages calculated from data in Table 1). Among clinicians who did use UDTs, none used UDTs for all their opioid prescribed patients.

For the least complex UDT (read by direct observation), PAs and NPs had a higher mean UDT count for opioid-prescribed patients (PAs: 4.2 UDTs; NPs: 3.6 UDTs; MDs: 2.7 UDTS; data not in table). For the most complex UDT (read by instrument chemistry analyzers, chromatography, and mass spectrometry), NPs had the highest mean UDT count, while PAs had a slightly lower UDT count compared to MDs (NPs: 9.1 UDTs; MDs: 5.2 UDTs; PAs: 4.8 UDTs; data not in table).

Among clinicians who used any UDTs (n = 101), midlevel clinicians (PAs and NPs collapsed into one group) had higher mean and median UDT use for opioid-prescribed patients compared to MDs (PA and NP mean: 24.3 % vs. MDs: 19.4 %; PA and NP median: 17.7 % vs. MDs: 12.5 %; data not in table), with a statistically significant difference ($p < 0.0001$).

Most sample primary care clinicians provided care in the office or special outpatient settings (93.6 %) and practiced in Nevada's urban counties (94.1 %). Higher proportions of MDs had patients with diagnosed MH and ND diagnoses ($p < 0.0001$), and AD and OSAD diagnoses ($p < 0.05$). For example, 9.2 % of MDs had 11 % or more opioid-prescribed patients diagnosed with OUD, compared to only 4.8 % of PAs and 7.7 % of NPs. Unadjusted odds ratios for UDT rates are available in Appendix C.

Table 1
Distribution of UDT rates and predictors by overall sample and primary care clinician type.

	Overall (N = 677) n(%)	Primary care clinician type (N = 802)		
		Physician (N = 412) n(%)	*Physician assistant (N = 105) n(%)*	*Nurse practitioner (N = 156) n(%)*
Outcome: UDT use[*]				
Percent of patients with UDT as a proportion of number of patients prescribed opioids per clinician				
0 % patients received UDTs	576 (85.1 %)	365 (88.6 %)	84 (80.0 %)	123 (78.9 %)
1–10 % patients received UDTs	55 (7.8 %)	18 (4.4 %)	15 (14.3 %)	20 (12.8 %)
11 % or more patients received UDTs	48 (7.1 %)	29 (7.0 %)	6 (5.7 %)	13 (8.3 %)
Primary care clinician-level characteristics				
Clinician setting				
Provides care in the office or special outpatient	634 (93.6 %)	390 (94.7 %)	92 (87.6 %)	149 (95.5 %)
Provides care in urgent care	43 (6.4 %)	22 (5.3 %)	13 (12.4 %)	7 (4.5 %)
Clinician location				
Urban	637 (94.1 %)	389 (94.4 %)	99 (94.3 %)	145 (93.0 %)
Rural or frontier	40 (5.9 %)	23 (5.6 %)	6 (5.7 %)	11 (7.0 %)
Patient-mix characteristics				
Percent of patients diagnosed with OUD[†] *as a proportion of number of patients prescribed opioids per clinician*				
0 % OUD patients	524 (77.4 %)	317 (76.9 %)	89 (84.8 %)	114 (73.1 %)
1–10 % OUD patients	98 (14.5 %)	57 (13.8 %)	11 (10.5 %)	30 (19.2 %)
11 % or more OUD patients	55 (8.1 %)	38 (9.2 %)	5 (4.8 %)	12 (7.7 %)
Percent of patients with opioid early refills[‡] *as a proportion of number of patients prescribed opioids per clinician*				
0 % patients with early refills	22 (3.3 %)	13 (3.2 %)	5 (4.8 %)	4 (2.6 %)
1–25 % patients with early refills	104 (15.4 %)	54 (13.1 %)	20 (19.1 %)	30 (19.2 %)
26–50 % patients with early refills	197 (29.1 %)	122 (29.6 %)	35 (33.3 %)	39 (25.0 %)
51–75 % patients with early refills	188 (27.8 %)	121 (29.4 %)	23 (21.9 %)	41 (26.3 %)
75 % or more patients with early refills	166 (24.5 %)	102 (24.8 %)	22 (21.0 %)	42 (26.9 %)
Percent of patients diagnosed with OSAD[§] *as a proportion of number of patients prescribed opioids per clinician*				
0 % OSAD patients	572 (84.5 %)	337 (81.8 %)	100 (95.2 %)	131 (84.0 %)

(continued on next page)

Table 1 (*continued*)

	Overall (N = 677) n(%)	Primary care clinician type (N = 802)		
		Physician (N = 412) n(%)	*Physician assistant (N = 105) n(%)*	*Nurse practitioner (N = 156) n(%)*
1–5 % OSAD patients	58 (8.6 %)	43 (10.4 %)	1 (1.0 %)	14 (9.0 %)
6 % or more OSAD patients	47 (6.9 %)	32 (7.8 %)	4 (3.8 %)	11 (7.1 %)
Percent of patients diagnosed with ND[¶] as a proportion of number of patients prescribed opioids per clinician				
0 % ND patients	290 (42.8 %)	145 (35.2 %)	65 (61.9 %)	76 (48.7 %)
1–17 % ND patients	193 (28.5 %)	129 (31.3 %)	22 (21.0 %)	42 (26.9 %)
18 % or more ND patients	194 (28.7 %)	138 (33.5 %)	18 (17.1 %)	38 (24.4 %)
Percent of patients diagnosed with AD[**] as a proportion of number of patients prescribed opioids per clinician				
0 % AD patients	531 (78.4 %)	312 (75.7 %)	89 (84.8 %)	126 (80.8 %)
1–4 % AD patients	77 (11.4 %)	52 (12.6 %)	10 (9.5 %)	15 (9.6 %)
5 % or more AD patients	69 (10.2 %)	48 (11.7 %)	6 (5.7 %)	15 (9.6 %)
Percent of patients diagnosed with MH[††] as a proportion of number of patients prescribed opioids per clinician				
0 % MH patients	216 (31.9 %)	96 (23.3 %)	55 (52.4 %)	63 (40.4 %)
1–28 % MH patients	272 (40.2 %)	181 (43.9 %)	35 (33.3 %)	56 (35.9 %)
29 % or more MH patients	189 (27.9 %)	135 (32.8 %)	15 (14.3 %)	37 (23.7 %)

[*] Number and percent of patients ordered UDT as a proportion of number of patients prescribed opioids per clinician.
[†] Includes opioid use disorder (ICD10: F11.1 and F11.2).
[‡] Early refills refer to a patient who requested a refill before 15 days of the previous opioid prescription supply date.
[§] Includes cannabis related disorders (ICD10: F12), cocaine related disorders (ICD10: F14), other stimulant related disorders (IDC10: F15) and opioid use disorder (ICD10: F11.1 and F11.2).
[¶] Includes nicotine dependence (ICD10: F17.2), problems related to lifestyle, tobacco use (ICD10: Z72.0).
[**] Includes alcohol related disorders (ICD10: F10).
[††] Includes bipolar affective disorder (ICD10: F31), post-traumatic stress disorder (ICD10: F43.1), general anxiety disorder (ICD10: F41.1), depression (ICD10: F33.9, F33.0, F33.1, F33.3, F33.2, F32.9, F32.2, F32.3, F06.32).

3.2. Adjusted odds ratios and predicted probabilities for presumptive UDT use

In Table 2, we reported adjusted odds ratios (AOR) of UDT rates, by primary care clinician-level and patient-mix characteristics. Consistent with the unadjusted analysis, we found that PAs and NPs had higher odds of UDT use compared to MDs (PAs AOR: 2.7, 95 % CI: 2.4, 3.0; NPs AOR: 1.7, 95 % CI: 1.5, 1.9). Additionally, primary care clinicians with higher proportions of patients diagnosed with OUD, OSAD, ND, and patients with early refills had significantly higher UDT rates compared to clinicians without any patients with one of these diagnoses, although the differences were small.

Table 2
Adjusted odds ratios from multivariate regression of presumptive UDT rates on primary care clinician-level and patient-mix characteristics.

Predictors	Clinician-level & patient-mix characteristics	
	AOR	*95 % CI*
Primary care clinician-level characteristics		
Clinician medical license type (ref = physician)		
Physician assistant	2.7**	(3.1, 3.7)
Nurse practitioner	1.7**	(2.1, 2.6)
Usual clinician setting (ref = office & special outpatient)		
Providing care in urgent care	0.03**	(0.004, 0.067)
Clinician location (ref = urban)		
Providing care in rural/frontier locations	1.6**	(0.8, 1.2)
Patient-mix characteristics		
Having patients diagnosed with opioid use disorder[†]	1.048**	(1.042, 1.053)
Having patients who request early refills[‡]	1.008**	(1.006, 1.009)
Having patients diagnosed with other substance abuse disorder[§]	1.105**	(1.090, 1.119)
Having patients diagnosed with nicotine disorder[¶]	1.005**	(1.003, 1.007)
Having patients diagnosed with alcohol disorder[††]	0.948**	(0.934, 0.962)
Having patients diagnosed with mental health condition[‡‡]	0.996*	(0.994, 0.998)

[*] $p < 0.001$.
[**] $p < 0.0001$.
[†] Includes opioid use disorder (ICD10: F11.1 and F11.2).
[‡] Early refills refer to a patient who requested a refill before 15 days of the previous opioid prescription supply date.
[§] Includes cannabis related disorders (ICD10: F12), cocaine related disorders (ICD10: F14), other stimulant related disorders (IDC10: F15) and opioid use disorder (ICD10: F11.1 and F11.2).
[¶] Includes nicotine dependence (ICD10: F17.2), problems related to lifestyle, tobacco use (ICD10: Z72.0).
[††] Includes alcohol related disorders (ICD10: F10).
[‡‡] Includes bipolar affective disorder (ICD10: F31), post-traumatic stress disorder (ICD10: F43.1), general anxiety disorder (ICD10: F41.1), depression (ICD10: F33.9, F33.0, F33.1, F33.3, F33.2, F32.9, F32.2, F32.3, F06.32).

In Table 3, we reported predicted probabilities for UDT use among primary care clinicians with opioid-prescribed patients, by primary care clinician-level characteristics. Holding other predictors at zero, PAs had the highest predicted probability of using UDTs compared to MDs (predicted probability: 2.1 %, 95 % CI: 0.5 %, 8.4 %).

3.3. Sensitivity analyses

The first, second, and third sensitivity analyses resulted in similar conclusions to the main analysis, particularly in the results for PAs and NPs (see Appendix D–F). Interestingly, while the variable added to the second sensitivity (measuring patients with 2 or more behavioral health opioid misuse risk factors) was significant, it was very close to 1, indicating no association may exist between clinicians having patients with two or more opioid misuse risk factors and using a UDT (AOR: 0.994, 95 % CI: 0.992, 0.995; see Appendix E). Our fourth sensitivity analysis examined the predicted probabilities among clinicians who had a consistent clinician setting listed for 50 % or more of their claims. This analysis was done to better assess whether the clinicians in our sample were primary care. While NPs rather than PAs had the highest predicted

Table 3
Predicted probabilities of primary care clinicians' use of presumptive UDT based on clinician-level characteristics.

Primary care clinician-level characteristics	Model from multivariate regression of UDT rates*	
	Predicted probability of UDT use†	95 % CI
Clinician medical license type (ref = physician)		
Physician assistant	2.1 %	(0.5, 8.4)
Nurse practitioner	1.3 %	(0.3, 5.4)
Clinician setting (ref = office & special outpatient)		
Providing care in urgent care	0.011 %	(0.002, 0.085)
Clinician location (ref = urban)		
Rural or frontier	0.7 %	(0.1, 3.0)

* Patient-mix characteristics were controlled for to calculate predicted probabilities.

† Number of patients ordered presumptive UDT as a proportion of number of patients prescribed opioids per clinician.

probability of ordering UDTs in this analysis (NPs: 2.2 %; PAs: 1.3 %), we still find higher use of UDTs among midlevel clinicians than among MDs.

4. Discussion

Despite known patient-level variation in UDTs and documented clinician-level variation in other practices related to opioid misuse mitigation, we know little about variation in UDT use among primary care clinicians. The current analysis of Nevada Medicaid data discovered three interesting patterns in a sample of Nevada primary care clinicians with opioid-prescribed patients. First, the overall provider-level rates of presumptive UDTs were relatively low among patients for whom guidelines recommend testing; second, PAs and NPs are the clinician medical license types most likely to use presumptive UDTs; and third, among clinicians who do use UDTs, PAs and NPS use UDTs at higher rates than MDs.

Overall, the study observed low use of UDTs consistently across all clinicians in the sample. This finding suggests that low use of UDTs across patients identified in the literature does not mask uneven UDT use among clinicians (Friedman et al., 2020; Larochelle et al., 2017; Starrels et al., 2011). The finding of higher UDT use among PAs and NPs has interesting implications related to increasing employment of PAs and NPs to lessen current and future shortages in generalist physicians across the United States (Zhang et al., 2020). Our findings suggest that this trend may increase uptake of UDTs.

Still, low overall UDT rates among clinicians merits further explanation; qualitative work offers some explanations. Studies have documented clinicians' concern that administering UDTs would weaken their relationships with patients and be superfluous given existing clinician-patient relationships (Keller et al., 2021; Krebs et al., 2014). This concern is valid; while interviews with patients revealed UDTs led to more open conversations with their physicians, they also revealed the viewpoint that opioid monitoring felt akin to a “law enforcement” role and an “invasion of privacy” (Krebs et al., 2014). Interviews with clinicians also reveal that the lack of adequate training, education, and time to administer and interpret UDTs result in lack of clinical clarity for how to respond to tests indicating substance misuse (Ceasar et al., 2016). Clinicians may have difficulties interpreting aberrant UDT results (Reisfield et al., 2007).

Educating providers about case studies pointing to the efficacy of UDTs in opioid harm mitigation could increase providers' use of UDTs. UDTs are a way to assess whether a patient is adhering to a treatment plan (i.e., taking their opioids) and to detect misuse (i.e., taking other substances; Ceasar et al., 2016). One study found that 46 % of patients receiving daily opioid therapy who tested positive for illicit drug use through UDT had denied the use of illicit drugs (Fleming et al., 2007). Another study followed chronic opioid users for a year and found 1 in 3 patients received UDT results that suggested possible misuse (Larochelle et al., 2021). This finding highlights the new information that can emerge through UDT use and UDT's role alongside other opioid harm mitigation tools (i.e., use of prescription drug monitoring programs, use of alternative treatments to prescription opioids, and having a contract with patients on opioid treatment).

Provider education targeting interpretation and documentation of UDTs may increase clinicians' comfort with UDTs, ultimately increasing their uptake. Provider education might also compare UDTs and other methods available to clinicians to test whether drugs are present in their patients' system (i.e., urine, sweat, hair, saliva). UDTs are the most common test because they are convenient, cheap, easy to collect, and have the sensitivity and specificity to detect commonly used drugs (Kale, 2019). However, more sensitive UDT tests may also be needed to detect certain other substances. One of the functions of UDTs, to identify other drug use (i.e., use of substances other than the prescribed opioids), may be hampered by false negatives, which may occur more frequently with novel synthetic opioids such as fentanyl (Kale, 2019). Confirmatory UDT tests may help to clarify the results, though the possibility of false negatives remains (Kale, 2019; Stammet & Spradley, 2016). The error rate for UDTs varies for different substances and highlights the importance for clinicians to receive training and select the appropriate testing methods best suited for the patient's treatment (Rosenfeld et al., 2020). Furthermore, clinicians may find it beneficial to consult with a toxicologist as research suggests most do not when they receive abnormal UDT results (Reisfield et al., 2007).

Certain health system–wide policies may increase UDT use (Krebs et al., 2014; Stammet & Spradley, 2016; Turner et al., 2014). At a large integrated health care system in Washington State, an evaluation of a multi-faceted chronic opioid use reduction intervention with practice guidelines (including recommendations for UDT) and physician training found a substantial increase in UDT among those receiving the intervention (Turner et al., 2014). More implementation science research employing behavioral change theories could help to identify effective ways to improve uptake of opioid risk mitigation tools such as UDTs, particularly in resource-constrained and nonintegrated health system settings.

Future research should assess whether the COVID-19 pandemic has impacted UDT use. The COVID-19 pandemic shifted many outpatient opioid prescribing follow-up visits to telehealth or phone call, and the American Society of Addiction Medicine (ASAM) has recommended clinicians reduce or eliminate UDT use to avoid unnecessary exposure to COVID-19 (American Society of Addiction Medicine, 2020). Although some clinicians may have requested that patients use outpatient labs for UDT testing, some likely shifted to using PDMPs and more frequent follow-up telemedicine visits to mitigate the risks associated with opioid prescribing. These changes may persist after the pandemic subsides, resulting in less reliance on UDT.

Our article has four limitations to note. One limitation is our data are limited in their generalizability. The dataset covers only one year of time, and it can only be generalized to primary care clinicians serving the Nevada Medicaid population. A second limitation is potential misattribution of clinician medical license type for PAs and NPs to MDs, in cases where the midlevel clinicians bill under the supervising MDs' provider identification. In this case, more UDTs would be misattributed to MDs, and our current results would underestimate the differences among MDs and PAs and NPs. A third limitation is that our dataset did not include data on clinicians' or patients' race or ethnicity; patients' race has been found to influence UDT receipt, and similar associations may exist for clinician race on UDT use (Becker et al., 2011; Hausmann et al., 2013; van Boekel et al., 2013). This will be an important factor to examine in a future study. Finally, we were not able to control for

practice-level characteristics, including the size of the practice or whether the practice is affiliated with a large health system. These could influence presumptive UDT use, as health systems or group practices may have policies around UDT, offer more resources for training and education, increase access to point-of-care tests, and/or have electronic health record reminders and/or registries to increase compliance with UDT policies. More research should seek to understand how practice characteristics influence use of opioid risk mitigation tools.

5. Conclusion

Although many papers have focused exclusively on physician behavior associated with opioid prescribing, in many states, PAs and NPs have prescriptive authority for Schedule II medications and must also contend with mitigating opioid misuse risks (KFF, 2015). This article examines differences in opioid prescribing risk mitigation via presumptive UDT in primary care medical license types, clinician setting, and clinician location. In conclusion, we found differences in primary care clinician use of presumptive UDTs by clinician medical license type (PAs and NPs were more like to use presumptive UDTs compared to MDs) and by the proportion of patients seen by a clinician with diagnoses or characteristics that increase the risk of opioid misuse. We found overall low rates of presumptive UDT use among patients at higher risk of opioid misuse, suggesting the need for more comprehensive health system interventions aimed at increasing the use of this opioid risk mitigation strategy.

Appendix A. Creation of the study sample

CRediT authorship contribution statement

Sarah Y. T. Hartzell: Designing research question, formulating study design, creation of study variables, analysis of data, writing of manuscript, editing of manuscript, formulating ideas for manuscript.

Michelle S. Keller: Designing research question, formulating study design, writing of manuscript, editing of manuscript, formulating ideas for manuscript.

Elaine Michelle Albertson: Writing of manuscript, formulating ideas for manuscript, editing of manuscript.

Yan Liu: Formulating study design, formulating ideas for manuscript, editing of manuscript.

Madalyn Larson: Formatting manuscript in the appropriate format, editing of manuscript.

Sarah Friedman: Designing research question, formulating study design, writing of manuscript, editing of manuscript, formulating ideas for manuscript.

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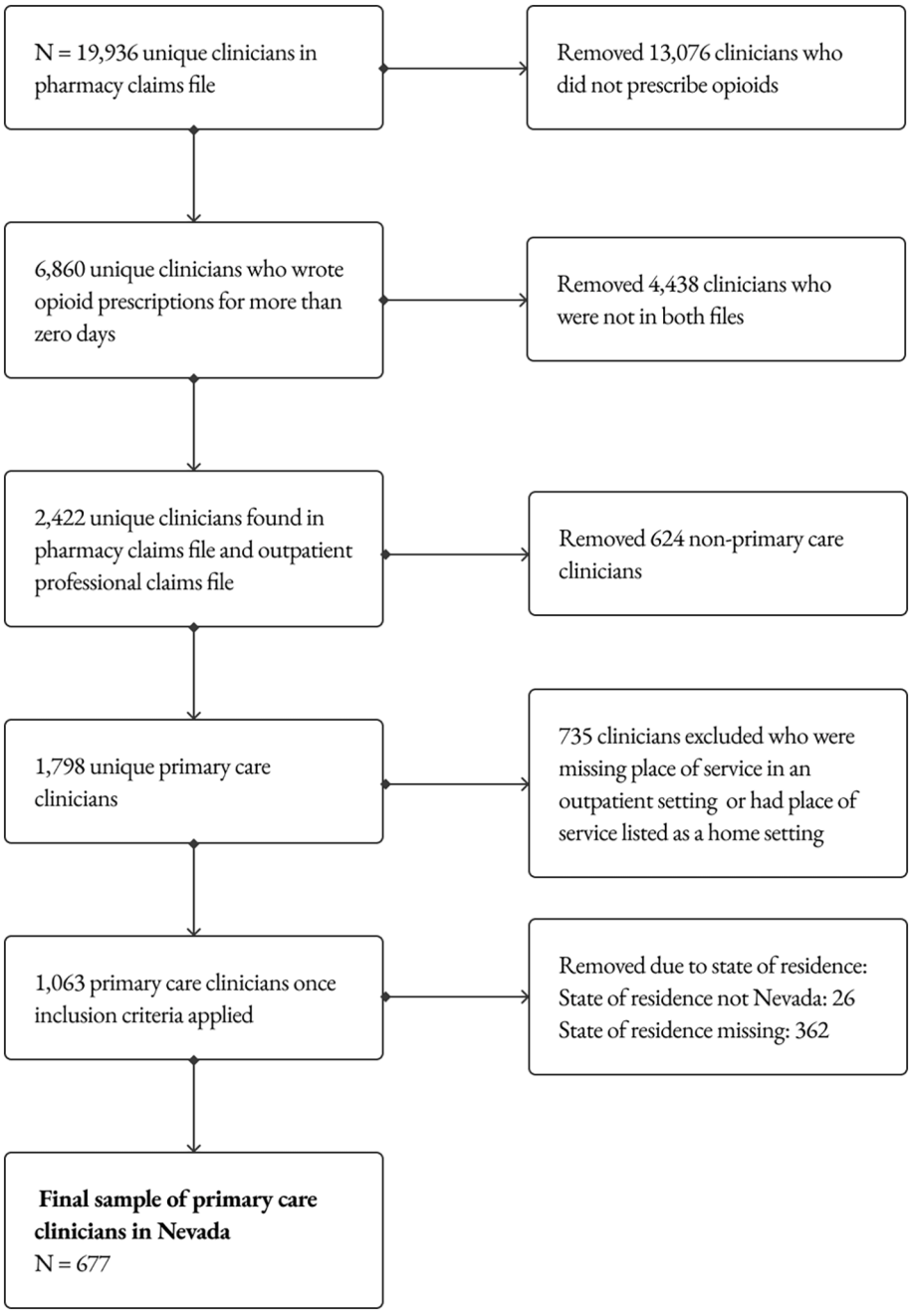
Declaration of competing interest

The authors have no conflict of interest to report.



Appendix B. How patient-mix characteristics were determined

Variable	How it was calculated
Having patients diagnosed with opioid use disorder	Patients had to have F11.1 and/or F11.2
Having patients who request early refills	Classified as a patient who requested a refill before/after 15 days of the previous supply date
Having patients diagnosed with other substance abuse disorder	Patients had to have F11.1 and/or F11.2
Having patients diagnosed with nicotine disorder	Patients had to have at least one of the following: nicotine dependence (F17.2), problems related to lifestyle, tobacco use (Z72.0)
Having patients diagnosed with alcohol disorder	Patients had to have alcohol related disorders (F10) =
Having patients diagnosed with mental health condition	Patients had to have at least one of the following: bipolar affective disorder (F31), post-traumatic stress disorder (F43.1), general anxiety disorder (F41.1), depression (F33.9, F33.0, F33.1, F33.3, F33.2, F32.9, F32.2, F32.3, F063.2)
Having patients with two or more behavioral health opioid misuse risk factors	This was a sum variable using the behavioral health opioid misuse risk factors to calculate patients with 2 or more.

Appendix C. Mean presumptive UDT rates and unadjusted odds ratios by primary care clinician and patient-mix characteristics

	Mean (SD) of UDT use[†]	Unadjusted OR	95 % CI
Primary care clinician-level characteristics			
Clinician medical license type			
Physician	2.2 (9.2)	0.61**	(0.56, 0.67)
Physician assistant	5.1 (15.5)	1.5**	(1.4, 1.7)
Nurse practitioner	5.9 (17.0)	1.0	(1.0, 1.3)
Clinician setting			
Provides care in the office or special outpatient	3.7 (12.9)	50.2**	(12.6, 100.9)
Providing care in urgent care	0.1 (0.6)	0.02**	(0.01, 0.08)
Clinician location			
Urban	3.6 (12.8)	0.8*	(0.7, 1.0)
Rural or frontier	1.0 (4.5)	1.3*	(1.1, 1.6)
Patient-mix characteristics			
Percent of patients diagnosed with OUD[‡] as a proportion of number of patients prescribed opioids per clinician			
0 % OUD patients	3.1 (12.0)	0.7**	(0.7, 0.8)
1–10 % OUD patients	4.7 (13.3)	0.7**	(0.7, 0.8)
11 % or more OUD patients	4.9 (15.2)	4.6**	(4.1, 5.3)
Percent of patients diagnosed with ER[§] as a proportion of number of patients prescribed opioids per clinician			
0 % ER patients	0.2 (0.9)	0.4	(0.1, 1.6)
1–25 % ER patients	2.7 (10.0)	0.5**	(0.5, 0.5)
26–50 % ER patients	2.6 (11.4)	1.2**	(1.1, 1.3)
51–75 % ER patients	2.6 (8.9)	1.3**	(1.1, 1.4)
75 % or more ER patients	6.3 (18.0)	1.2*	(1.1, 1.3)
Percent of patients diagnosed with OSAD[¶] as a proportion of number of patients prescribed opioids per clinician			
0 % OSAD patients	3.5 (12.7)	1.2*	(1.1, 1.4)
1–5 % OSAD patients	1.1 (4.5)	0.4**	(0.3, 0.5)
6 % or more OSAD patients	6.1 (16.6)	2.6**	(2.2, 3.1)
Percent of patients diagnosed with ND[††] as a proportion of number of patients prescribed opioids per clinician			
0 % ND patients	4.2 (14.6)	0.5**	(0.4, 0.5)
1–17 % ND patients	4.2 (13.5)	2.5**	(2.3, 2.7)
18 % or more ND patients	1.7 (6.7)	0.7**	(0.7, 0.8)
Percent of patients diagnosed with AD[‡‡] as a proportion of number of patients prescribed opioids per clinician			
0 % AD patients	3.4 (12.3)	0.5**	(0.5, 0.6)
1–4 % AD patients	3.3 (12.6)	2.0**	(1.8, 2.2)
5 % or more AD patients	4.3 (14.1)	1.2	(1.0, 1.4)
Percent of patients diagnosed with MH[§§] as a proportion of number of patients prescribed opioids per clinician			
0 % MH patients	4.7 (15.0)	0.5**	(0.5, 0.6)
1–28 % MH patients	3.3 (12.1)	1.9**	(1.7, 2.0)
29 % or more MH patients	2.4 (9.8)	1.0	(0.9, 1.2)

* $p < 0.001$.

** $p < 0.0001$.

† Number of patients ordered presumptive UDT as a proportion of number of patients prescribed opioids per clinician.

‡ Includes opioid use disorder (ICD10: F11.1 and F11.2).

§ Early refills refer to a patient who requested a refill before 15 days of the previous opioid prescription supply date.

¶ Includes cannabis related disorders (ICD10: F12), cocaine related disorders (ICD10: F14), other stimulant related disorders (IDC10: F15) and opioid use disorder (ICD10: F11.1 and F11.2).

†† Includes nicotine dependence (ICD10: F17.2), problems related to lifestyle, tobacco use (ICD10: Z72.0).

‡‡ Includes alcohol related disorders (ICD10: F10).

§§ Includes bipolar affective disorder (ICD10: F31), post-traumatic stress disorder (ICD10: F43.1), general anxiety disorder (ICD10: F41.1), depression (ICD10: F33.9, F33.0, F33.1, F33.3, F33.2, F32.9, F32.2, F32.3, F06.32).

Appendix D. Sensitivity analysis 1 for adjusted odds ratios from multivariate regression of presumptive UDT rates on primary care clinician-level and patient-mix characteristics[†]

Predictors	Clinician-level & patient-mix characteristics	
	AOR	*95 % CI*
Primary care clinician-level characteristics		
Clinician medical license type (ref = physician)		
Physician assistant	2.3*†	(2.1, 2.5)
Nurse practitioner	1.5*	(1.4, 1.7)
Usual clinician setting (ref = office & special outpatient)		
Providing care in urgent care	0.012*	(0.003, 0.050)
Patient-mix characteristics		
Having patients diagnosed with opioid use disorder[‡]	1.034*	(1.030, 1.039)
Having patients who request early refills[§]	1.007*	(1.006, 1.009)
Having patients diagnosed with other substance abuse disorder[¶]	1.030*	(1.019, 1.040)
Having patients diagnosed with nicotine disorder**	1.001	(1.000, 1.003)
Having patients diagnosed with alcohol disorder[††]	0.992	(0.983, 1.002)
Having patients diagnosed with mental health condition[‡‡]	0.998*	(0.997, 0.999)

* $p < 0.0001$.
† Using the full 1063 sample by including clinicians who were missing a city in the dataset.
‡ Includes opioid use disorder (ICD10: F11.1 and F11.2).
§ Early refills refer to a patient who requested a refill before 15 days of the previous opioid prescription supply date.
¶ Includes cannabis related disorders (ICD10: F12), cocaine related disorders (ICD10: F14), other stimulant related disorders (IDC10: F15) and opioid use disorder (ICD10: F11.1 and F11.2).
** Includes nicotine dependence (ICD10: F17.2), problems related to lifestyle, tobacco use (ICD10: Z72.0).
†† Includes alcohol related disorders (ICD10: F10).
‡‡ Includes bipolar affective disorder (ICD10: F31), post-traumatic stress disorder (ICD10: F43.1), general anxiety disorder (ICD10: F41.1), depression (ICD10: F33.9, F33.0, F33.1, F33.3, F33.2, F32.9, F32.2, F32.3, F06.32).

Appendix E. Sensitivity analysis 2 for adjusted odds ratios from multivariate regression of presumptive UDT rates on primary care clinician-level, patient-mix characteristic, and comorbidity variable

Predictors	AOR	95 % CI
Primary care clinician-level characteristics		
Clinician medical license type (ref = physician)		
Physician assistant	3.0**	(2.8, 3.4)
Nurse practitioner	2.0**	(1.8, 2.2)
Usual clinician setting (ref = office & special outpatient)		
Providing care in urgent care	0.025**	(0.002, 0.032)
Clinician location (ref = urban)		
Providing care in rural/frontier locations	1.4*	(1.1, 1.7)
Patient-mix characteristics		
Having patients diagnosed with OUD†	1.05**	(1.04, 1.06)
Having patients who request early refills‡	1.01**	(1.00, 1.01)
Having patients diagnosed with other substance abuse disorder§	1.10*	(1.09, 1.12)
Having patients diagnosed with nicotine disorder¶	1.003	(1.001, 1.006)
Having patients diagnosed with alcohol disorder††	0.957**	(0.943, 0.971)
Having patients diagnosed with mental health condition‡‡	0.997	(0.998, 0.999)
Having patients with 2 or more behavioral health opioid misuse risk factors	0.994**	(0.992, 0.995)

* $p < 0.05$.
** $p < 0.0001$.
† Includes opioid use disorder (ICD10: F11.1 and F11.2).
‡ Early refills refer to a patient who requested a refill before 15 days of the previous opioid prescription supply date.
§ Includes cannabis related disorders (ICD10: F12), cocaine related disorders (ICD10: F14), other stimulant related disorders (IDC10: F15) and opioid use disorder (ICD10: F11.1 and F11.2).
¶ Includes nicotine dependence (ICD10: F17.2), problems related to lifestyle, tobacco use (ICD10: Z72.0).
†† Includes alcohol related disorders (ICD10: F10).
‡‡ Includes bipolar affective disorder (ICD10: F31), post-traumatic stress disorder (ICD10: F43.1), general anxiety disorder (ICD10: F41.1), depression (ICD10: F33.9, F33.0, F33.1, F33.3, F33.2, F32.9, F32.2, F32.3, F06.32).

Appendix F. Sensitivity analysis 3 for adjusted odds ratios from multivariate regression of volume of presumptive UDT on primary care clinician-level and patient-mix characteristics†

Predictors	Clinician-level & patient-mix characteristics	
	AOR	*95 % CI*
Primary care clinician-level characteristics		
Clinician medical license type (ref = physician)		
Physician assistant	3.4*†	(3.1, 3.7)
Nurse practitioner	2.3*	(2.1, 2.6)
Usual clinician setting (ref = office & special outpatient)		
Providing care in patient's home	0.03*	(0.01, 0.08)
Providing care in urgent care	0.026*	(0.004, 0.067)
Clinician location (ref = urban)		
Providing care in rural/frontier locations	1.3*	(1.1, 1.5)
Patient-mix characteristics		
Having patients diagnosed with opioid use disorder‡	1.06*	(1.05, 1.06)
Having patients who request early refills§	1.004*	(1.003, 1.006)
Having patients diagnosed with other substance abuse disorder¶	1.03*	(1.02, 1.04)
Having patients diagnosed with nicotine disorder††	1.01*	(1.01, 1.01)
Having patients diagnosed with alcohol disorder‡‡	0.96*	(0.95, 0.98)
Having patients diagnosed with mental health condition§§	0.99*	(0.99, 1.00)

* $p < 0.0001$.
† Based on the outcome total volume of presumptive UDT use as the proportion of opioid-prescribed patients seen by the clinician who had at least one presumptive UDT within 15 days of an opioid prescription.
‡ Includes opioid use disorder (ICD10: F11.1 and F11.2).
§ Early refills refer to a patient who requested a refill before 15 days of the previous opioid prescription supply date.

[¶] Includes cannabis related disorders (ICD10: F12), cocaine related disorders (ICD10: F14), other stimulant related disorders (IDC10: F15) and opioid use disorder (ICD10: F11.1 and F11.2).

[††] Includes nicotine dependence (ICD10: F17.2), problems related to lifestyle, tobacco use (ICD10: Z72.0).

[‡‡] Includes alcohol related disorders (ICD10: F10).

[§§] Includes bipolar affective disorder (ICD10: F31), post-traumatic stress disorder (ICD10: F43.1), general anxiety disorder (ICD10: F41.1), depression (ICD10: F33.9, F33.0, F33.1, F33.3, F33.2, F32.9, F32.2, F32.3, F06.32).

Appendix G. Sensitivity analysis 4 for predicted probabilities of primary care clinicians' use of presumptive UDT based on clinician-level characteristics for clinicians with consistent clinician setting for 50 % or more of their claims

Primary care clinician-level characteristics	Model from multivariate regression of UDT rates*	
	Predicted probability of UDT use†	95 % CI
Clinician medical license type (ref = physician)		
Physician assistant	1.3 %	(0.3, 5.4)
Nurse practitioner	2.2 %	(0.3, 5.5)
Clinician setting (ref = office & special outpatient)		
Providing care in urgent care	0.06 %	(0.01, 0.42)
Clinician location (ref = urban)		
Rural or frontier	2.0 %	(0.4, 8.0)

[*] Patient-mix characteristics were controlled for to calculate predicted probabilities.

[†] Number of patients ordered presumptive UDT as a proportion of number of patients prescribed opioids per clinician.

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