

# Moderate IV Sedation Simulation with iTIVA App

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## Introduction

There are many ways to accomplish Moderate Sedation. In our Pediatric Dental Residency Program, the use of Moderate IV Sedation is frequently used to help accomplish dental work for young children, that otherwise wouldn't be able to be completed due to poor behavior. Currently, we use a weight based algorithm where we use Midazolam, Fentanyl, (Figure 1) and Dexmedetomidine (Figure 2) in a specific order and timing to accomplish the desired sedation level.

The iTIVA® app plots Plasma and BioPhase levels for patients with different ages / weights and for different sedation agents. The iTIVA® app is an Anesthesia pharmacokinetic modeling app designed in Columbia, available for iPhone/iPad use. It can plot both Plasma and BioPhase drug levels for commonly used sedation agents.

The purpose of this study is to evaluate our Pediatric Moderate IV Sedation algorithm using the iTIVA® app. Our specific interest was evaluating if our algorithm allowed sufficient time for BioPhase levels (concentration of sedative agent at it's effect site) to peak prior to subsequent dosing.

## Methods

We created three SIM groups based upon ages/weight as well as two known scenarios to evaluate our dosing algorithm. The majority of the SIM cases were Midazolam and Fentanyl with Dexmedetomidine added for certain indications. For each of these SIM-Patients the Plasma level and BioPhase level for the sedatives used were plotted on a time-based graph. The iTIVA® app did not have BioPhase plotting capability for pediatric Midazolam, however after contacting the App developer and submitting pharmacokinetic publications, he kindly added this to a beta test version for our research project. This modification update is now available for all app users.

Figure 1

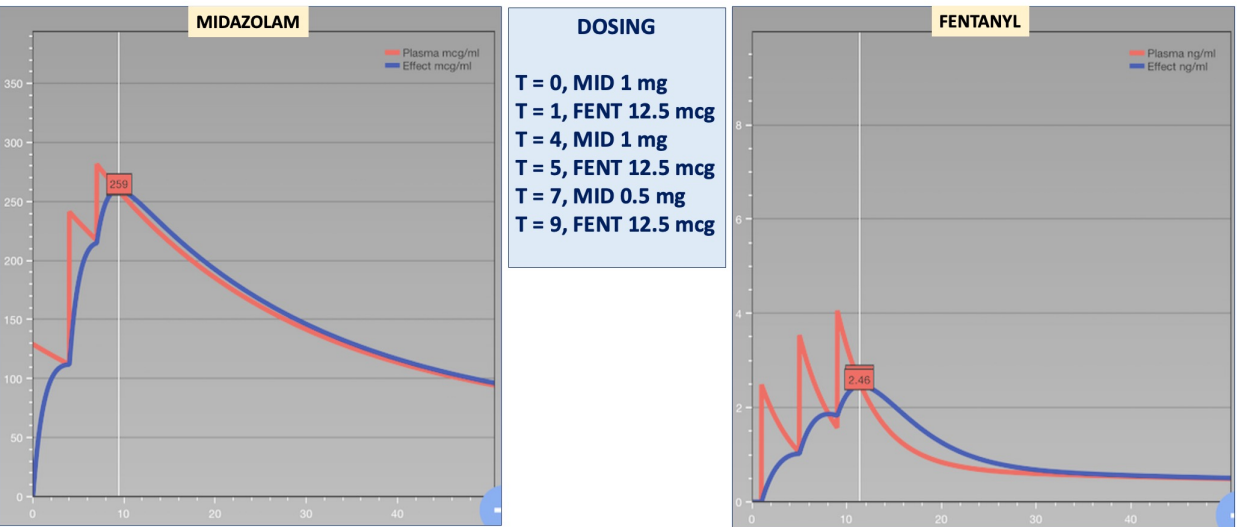
2021 MOD PED IV SEDATION DOSE REGIMEN, GUIDE AND DOSING ALGORITHM											
WEIGHT (kg)	MIDAZOLAM 1 MG/ML, USUALLY 2 ML VIAL				FENTANYL 50 MCG/ML, USUALLY 2 ML VIAL				MID/FENT Dosing per KG		
	STARTING DOSING				ADDITIONAL DOSING				MAXIMUM DOSE/KG		
	FIRST MID (mg)	SECOND MID (mg)	FIRST FENT (mcg)	SECOND FENT (mcg)	SUBSEQ. MID (mg)	SUBSEQ. FENT (mcg)	TOTAL MID (mg)	TOTAL FENT (mcg)	WEIGHT (kg)	MID (~mg/kg)	FENT (~mcg/kg)
15 to 20	1	1	12.5	12.5	0.5	12.5	5	50	15 to 20	0.33	3.3
21 to 25	1	1	25	12.5	0.5	12.5	6	62.5	21 to 25	0.30	3.1
26 to 30	1.5	1	25	25	0.5	12.5	7	75	26 to 30	0.27	2.9
31 to 35	2	1	25	25	0.5 or 1	12.5	8	87.5	31 to 35	0.26	2.8
36 to 40	2	1	50	25	0.5 or 1	12.5	8	100	36 to 40	0.22	2.8
41 to 45	2	1.5	50	25	0.5 or 1	25	8	125	41 to 45	0.20	3.0
46 to 50	2	2	50	25	1	25	9	150	46 to 50	0.20	3.3
51 to 60	2	2	50	50	1	25	9	175	51 to 60	0.20	3.4
60+	2	2	50	50	1 or 2	25	10	200	60+	0.16	3.3

Figure 2

2021 MOD PED IV SEDATION DOSE REGIMEN, GUIDE AND DOSING ALGORITHM											
ADJUNCT SEDATION OPTIONS:											
A) DEXMEDETOMIDINE ONLY TO BE DRAWN UP AND DILUTED BY ANESTHESIOLOGIST											
INDICATIONS FOR DEXMEDETOMIDINE											
1) PREVIOUSLY USED FOR IV MOD SEDATION: TITRATE IN AT BEGINNING INTERSPERSED WITH MID/FENT											
2) PREVIOUSLY POOR IV MOD SEDATION: TITRATE IN AT BEGINNING INTERSPERSED WITH MID/FENT											
3) VERY AGITATED CHILD AFTER IV PLACED, ESPECIALLY IF YOUNGER, HAS ADHD OR ASD											
4) INITIAL 4 DOSES OF MID/FENT GIVEN AND CHILD STILL VERY UPSET CRYING: TITRATE IN OVER NEXT 5 MINUTES											
5) 1/2 TO 2/3 OF MAX DOSE USED AND PATIENT STILL NOT SEDATED / CRYING: TITRATE IN OVER NEXT 5 MINUTES											
6) MAX DOSE OF MID/FENT USED AND CASE REQUIRES FURTHER SEDATION TIME: TITRATE IN OVER NEXT 5 MINUTES											
DEXMEDETOMIDINE DOSING											
100 MCG/ML, USUALLY 2 ML VIAL, PRECEDEX® IS THE TRADE NAME FOR DEXMEDETOMIDINE											
HOW TO PREPARE DEXMEDETOMIDINE SYRINGE											
1. DRAW UP ~ 0.8 MCG/KG OF DEXMEDETOMIDINE INTO A 1 ML SYRINGE, AS DIRECTED BY THE DOSING TABLE											
2. DRAW UP 10 ML OF NORMAL SALINE INTO A 10 ML SYRINGE											
3. ADD DEXMEDETOMIDINE TO THE 10 ML SYRINGE, WILL HAVE SLIGHTLY MORE THAN 10 MLS, THIS IS OK											
4. ADMINISTER DEXMEDETOMIDINE IN 1 ML DOSES, MAX 6 DOSES (6 ML), USING THE DOSING SCHEDULES BELOW											
1) DOSING SCHEDULE: AT THE START OF THE CASE											
2) DOSING SCHEDULE: DEXMEDETOMIDINE ADDED DURING THE CASE											
DO NOT GIVE RAPID BOLUS OF DEXMEDETOMIDINE DUE TO SEVERE BRADYCARDIA / ASYSTOLE RISK											
DO NOT ADMINISTER MORE THAN 6 DOSES OF DEXMEDETOMIDINE, IF THE PATIENT BECOMES APPROPRIATELY SEDATED YOU MAY OMIT SOME OF THE PLANNED DOSES											
CAUTION: DEXMEDETOMIDINE'S SYNERGISTIC EFFECT MAY DECREASE THE DOSE REQUIREMENTS FOR MIDAZOLAM AND FENTANYL, TITRATE THESE SEDATIONS APPROPRIATELY											
CAUTION: THE ONSET OF DEXMEDETOMIDINE IS SLOW; YOU MAY HAVE TO WAIT 5 MINUTES TO SEE EFFECT, AND FULL EFFECT 10+ MINUTES											
AFTER DEXMEDETOMIDINE LOAD, NO FURTHER SEDATION SHOULD BE GIVEN UNTIL YOU HAVE WAITED 4 MINUTES TO ALLOW FOR THE SLOWER ONSET OF DEXMEDETOMIDINE											
CAUTION: DEXMEDETOMIDINE CAN POTENTIATE RESPIRATORY DEPRESSION FROM OTHER SEDATIVES, THIS MAY BE DELAYED											
CAUTION: THERE IS NO REVERSAL AGENT FOR DEXMEDETOMIDINE DEXMEDETOMIDINE LOAD SHOULD BE OVER A MINIMUM OF 5 MINUTES											

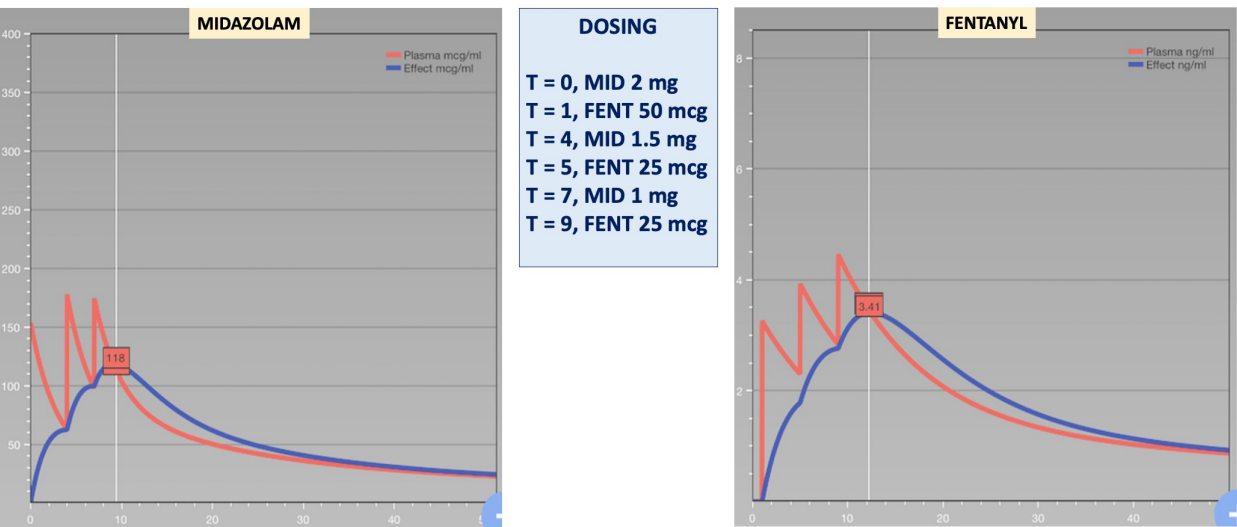
### SIM 1: 5 year old BMI 15

Midazolam 1<sup>st</sup> dose had peaked but second dose hadn't peaked completely prior to 3<sup>rd</sup> dose, Fentanyl dosing seems appropriate.



### SIM 2: 5 year old BMI 35

Midazolam dosing sequence is appropriate, Fentanyl 1<sup>st</sup> dose hadn't reached peak effect prior to second dose.

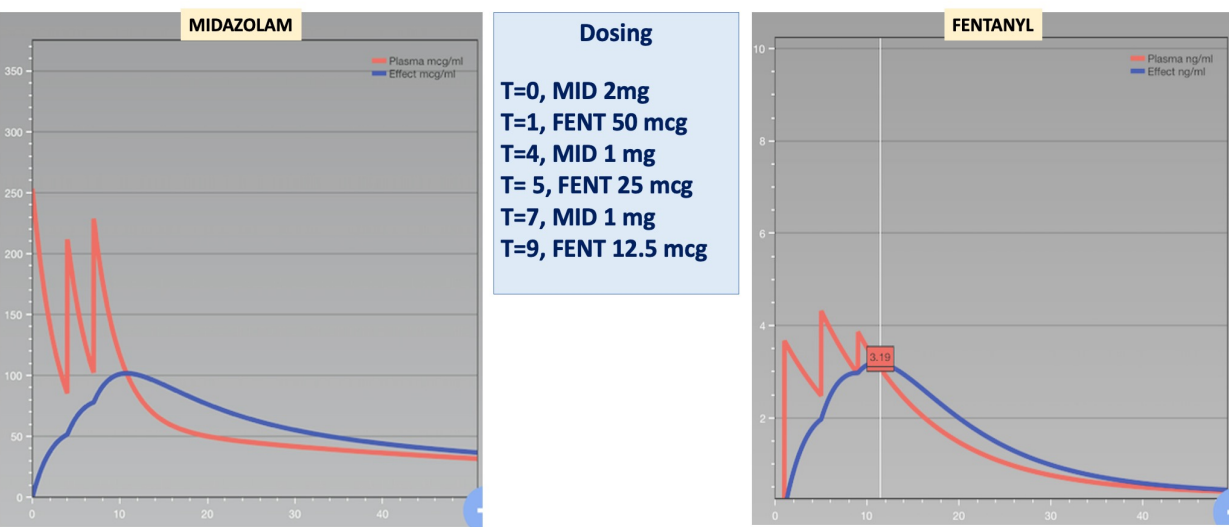


## Results

Overall we created sedation SIM plots for 20 SIM-patients. Age groups were 5 years, 13 years and 18 years. BMI groups were 15, 20 or 25 and 35. Use of Dexmedetomidine early or late or as indicated. Examples are shown below (SIM 1 through 7).

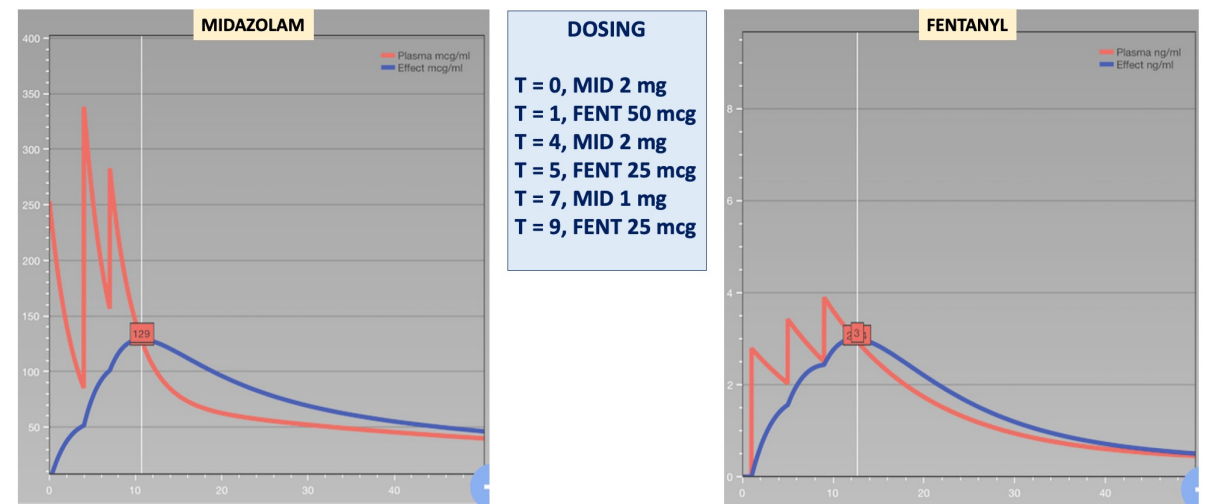
### SIM3: 13 year old BMI 15

Midazolam and Fentanyl Dosing is appropriate.



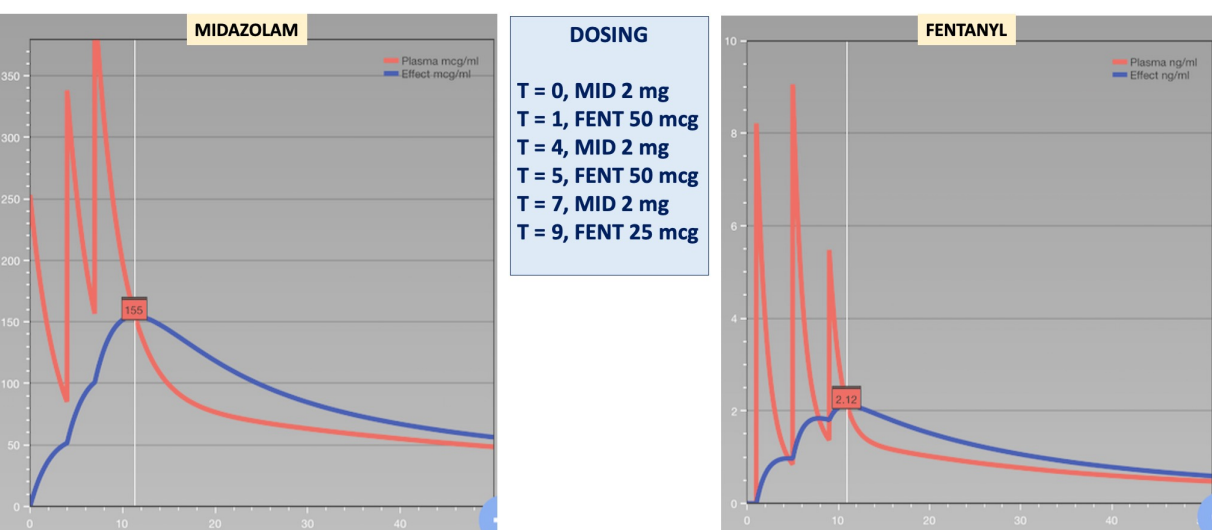
### SIM 4: 13 year old BMI 20

Midazolam the second dose is given prior to the first dose reaching peak effect, Fentanyl dosing is appropriate.



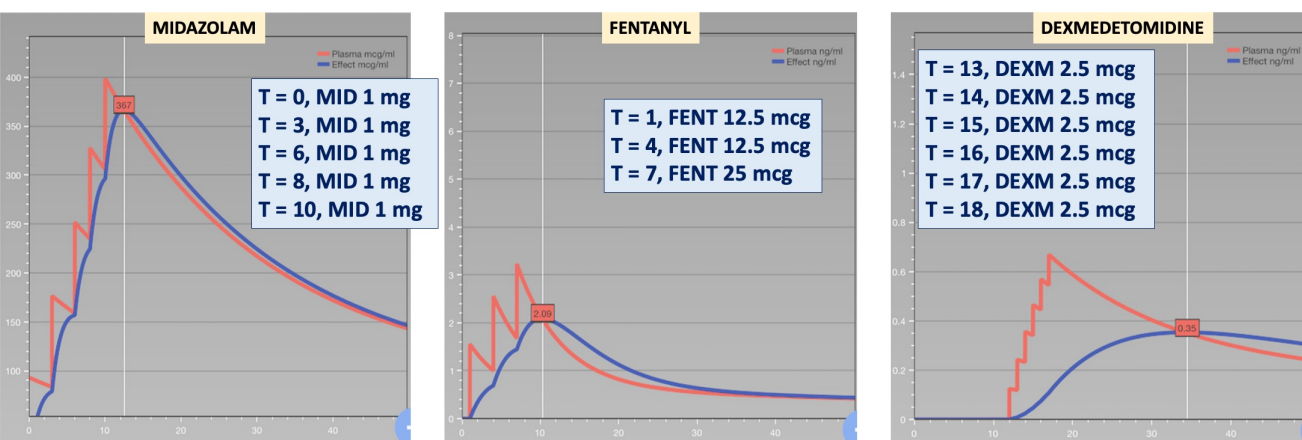
### SIM 5: 18 year old BMI 25

The third dose of Midazolam is given prior to the second dose reaching peak effect. Fentanyl dosing is appropriate.



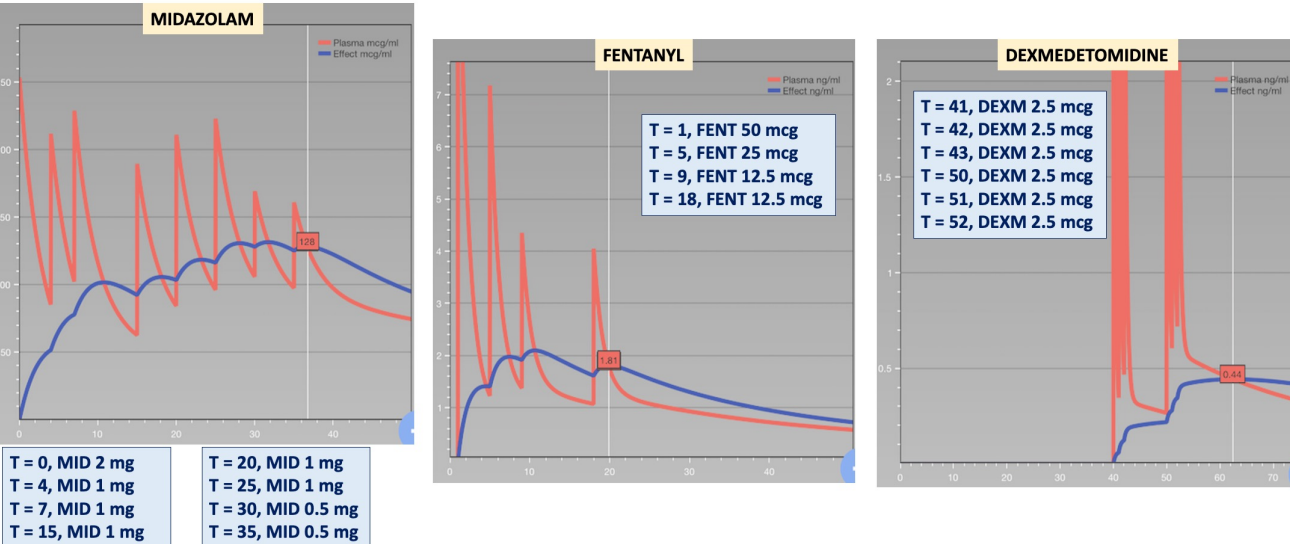
### SIM 6: Very Difficult to sedate 5 year old BMI 15

After maxing out on Midazolam and Fentanyl, Dexmedetomidine is used and provides a good long term sedation effect, note slow onset and delay to peak effect.



### SIM 7: 13 year old BMI 15 Prolonged Case

During a long case all the Midazolam and Fentanyl medications were used, Dexmedetomidine provided additional sedation to allow treatment completion.



## Conclusions

With sedation, safety is of utmost importance. This study helped better evaluate our current Moderate IV Sedation protocol from a pharmacokinetic point of view. BioPhase levels do peak several minutes after peak IV levels, so an appropriate dosing interval is required. Older patients would appear to require a greater interval due to the slower Initial redistribution effect. After reviewing the different scenarios, the data suggests that our sedation protocol is appropriate and safe.