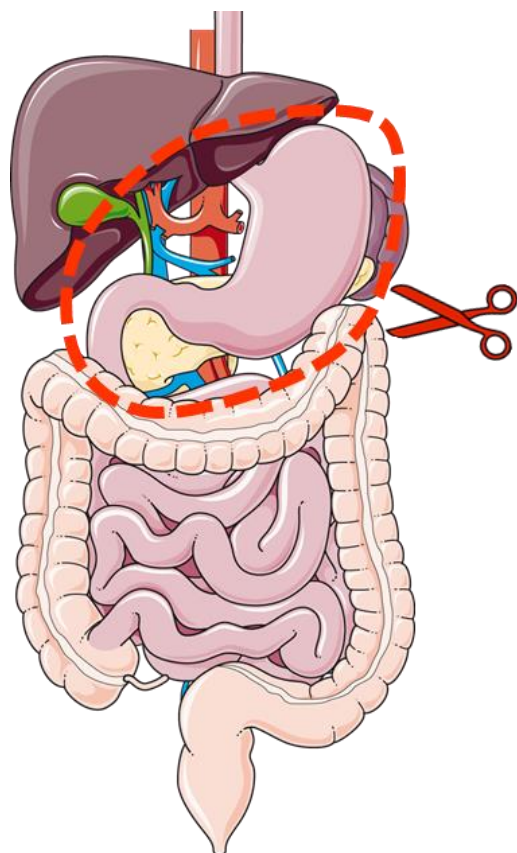


## Effect of Gastrointestinal Surgery on ARV Absorption

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### Bariatric Surgery

Adapted from: [www.smart.servier.com](http://www.smart.servier.com)

### Potential Key Changes after Bariatric Surgery

	<i>Sleeve Gastrectomy</i>	<i>Roux-en-Y Gastric Bypass</i>
<b>Gastric motility</b>	Likely impaired	Likely impaired
<b>Gastric volume</b>	Decreased	Decreased
<b>Gastric pH</b>	Increased	Increased
<b>Surface area</b>	No change or possible decrease	Decreased contact with stomach and intestinal surface
<b>First pass metabolism</b>	Not affected	Potentially reduced since proximal small intestine has high CYP3A4. Also bypass some transporter activity.

### Site of Absorption of ARVs and Relevant DDIs after Bariatric Surgery

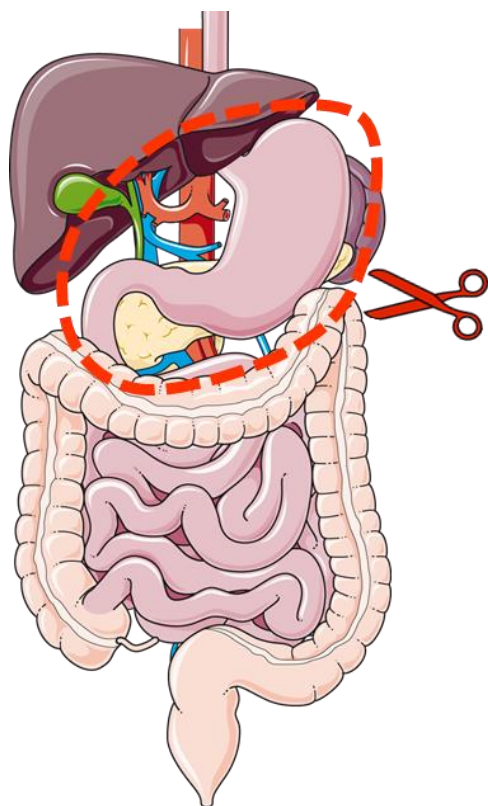
<i>ARV</i>	<i>Site of Absorption</i>	<i>AUC (fasting vs fed)</i>	<i>Relevant DDIs Post-surgery</i>
Abacavir	Duodenum		
Atazanavir	Small intestine	↓ 33%	PPI (contraindicated); Antacid/H2RA (caution)
Darunavir	Small intestine	↓ 30% (bioavailability)	
Dolutegravir	Proximal small intestine	↓ 66% (cf high fat meal)	Divalent cations (separate administration)
Etravirine	Unknown	↓ 50%	
Emtricitabine	Likely duodenum		
Lamivudine	Duodenum, jejunum		
Lopinavir	Jejunum		
Raltegravir	Ileum		Divalent cations (separate administration)
Rilpivirine	Unknown	↓ 40%	PPI (contraindicated); Antacid/H2RA (caution)
Ritonavir	Unknown		
Tenofovir-DF	Likely duodenum	↓ 40%	

# Effect of Gastrointestinal Surgery on ARV Absorption

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## Bariatric Surgery

Adapted from: [www.smart.servier.com](http://www.smart.servier.com)

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## Pharmacokinetics of ARVs following Bariatric Surgery

<i>Antiretroviral</i>	<i>Sleeve Gastrectomy</i>	<i>Roux-en-Y Gastric Bypass</i>
Abacavir (ABC)	↔ <sup>1</sup>	
Atazanavir (ATV)	↓ <sup>1</sup> , ↓ <sup>2</sup> , ↓ <sup>3</sup>	
Darunavir (DRV)	↔ <sup>2</sup>	↓ (3 days) <sup>4</sup> , ↔ (10 weeks) <sup>4</sup> , ↔ <sup>5</sup>
Dolutegravir (DTG)		↔ (3 patients) <sup>6</sup> , ↓ (1 patient) <sup>6</sup> , ↔ <sup>2</sup>
Emtricitabine (FTC)	↔ <sup>1</sup> , ↔ <sup>7</sup> , ↔ <sup>2</sup>	↓ (3 days) <sup>4</sup> , ↔ (10 weeks) <sup>4</sup> , ↔ <sup>5</sup> , ↓ <sup>8</sup>
Etravirine (ETR)	↔ <sup>3</sup>	
Lamivudine (3TC)	↔ <sup>1</sup>	↔ <sup>9</sup> , ↓ <sup>10</sup>
Lopinavir (LPV)		↔ <sup>11</sup> , ↓ <sup>10</sup>
Raltegravir (RAL)	↓ <sup>1</sup> , ↔ <sup>2</sup>	
Ritonavir (RTV)	↔ <sup>1</sup> ,	↓ (3 days) <sup>4</sup> , ↑ (10 weeks) <sup>4</sup> , ↓ <sup>5</sup> , ↔ <sup>11</sup>
Tenofovir-DF (TDF)*	↔ <sup>1</sup> , ↓ <sup>7</sup> , ↓ <sup>12</sup>	↔ <sup>4</sup> , ↓ <sup>5</sup> , ↓ <sup>8</sup>

\* Individuals receiving TDF for PrEP (i.e. uninfected) had decreased tenofovir exposure.

## Conclusions

- Data limited to individual case reports or case series.
- Timing of sample collection post-surgery varies.
- Pharmacokinetics are more likely to be altered in the early stage post-surgery.
- Following sleeve gastrectomy, decreased exposure of RAL, ATV and possibly TDF (data from one study).
- Following Roux-en-Y gastric bypass surgery, data are highly variable and in part related to time of study post-surgery. Evidence of decreased exposure of TDF, FTC, DRV, RTV, DTG.
- TDM (if available) will help to guide dosing.

## Recommendations

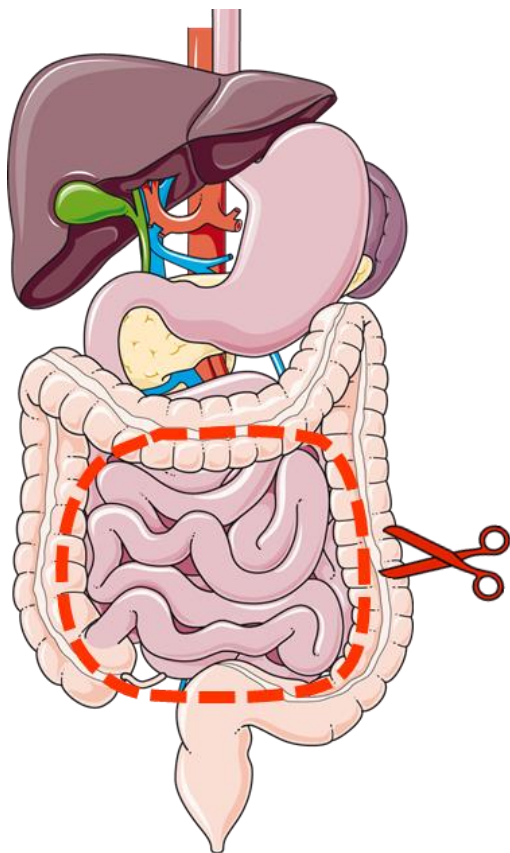
<i>Antiretroviral</i>	<i>Prescribing Recommendation</i>
Atazanavir; Rilpivirine	Avoid due to impaired absorption as a result of increased gastric pH
Integrase Inhibitors	Separate administration from mineral supplements
Dolutegravir; Etravirine; Tenofovir-DF	Exposure reduced in fasted condition, administer with food
Dolutegravir (DTG)	Consider DTG 50 mg twice daily in the early phase post-surgery. Determine maintenance dose by performing TDM (where feasible).
Darunavir/ritonavir (DRV/r)	Consider DRV/r 600 mg twice daily in the early phase post-surgery. Determine maintenance dose by performing TDM (where feasible).

## Effect of Gastrointestinal Surgery on ARV Absorption

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### Small Bowel Resection

Adapted from: [www.smart.servier.com](http://www.smart.servier.com)

### Potential Key Changes after Small Bowel Resection Surgery (and Pancreaticoduodenectomy)

<b>Absorption</b>	Impact on absorption will depend on the amount of bowel removed.
<b>Intestinal transit</b>	Likely more rapid – i.e. less time for absorption
<b>Bile salt absorption</b>	Disrupted and can lead to choleric diarrhoea and decreased absorption of some drugs
<b>Fat absorption</b>	Disrupted leading to malabsorption of some drugs
<b>Bacterial overgrowth</b>	Possible effect on absorption?
<b>Additional medications</b>	Possible effect on absorption?

### Pharmacokinetics of ARVs Following Small Bowel Resection

<i>Antiretroviral (via NG tube)</i>	<i>Pharmacokinetic change described in case report*</i>
Darunavir	Peak plasma concentration within normal range but rapidly eliminated
Etravirine	Markedly decreased plasma concentrations
Lopinavir	Markedly decreased plasma concentrations
Maraviroc	Plasma concentrations within normal range
Raltegravir	Decreased plasma concentrations.
Ritonavir	Markedly decreased plasma concentrations

\* Ikuma M et al. *Intern Med* 2016; 55(20):3059-3063.

### Conclusions

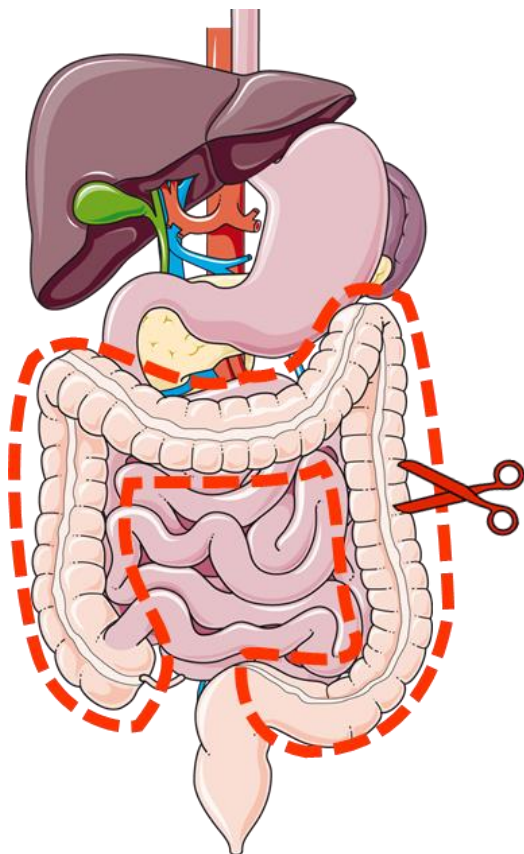
- Limited data (case report) but evidence of decreased exposure of most ARVs studied.
- TDM (if available) will help to guide dosing.

# Effect of Gastrointestinal Surgery on ARV Absorption

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## Colonic Resection



Adapted from: [www.smart.servier.com](http://www.smart.servier.com)

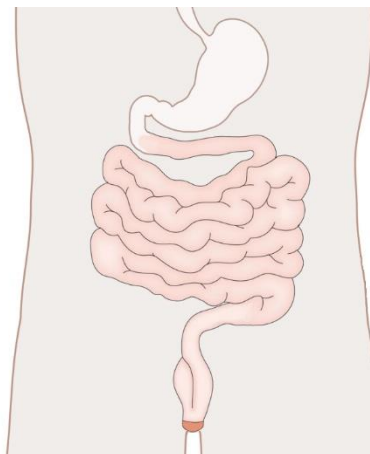
### Potential Key Changes After Colonic Resection

	<i>Part Removal</i>	<i>Total Colectomy</i>
<b>Absorptive Capacity</b>	Little change	Absorptive site for some drugs is removed. No evidence that this impacts ARVs.
<b>Enterohepatic recycling (EHC)</b>	Probably little change	Lack of EHC may impact drugs undergoing extensive hepatic conjugation and biliary excretion, e.g., raltegravir.

### Effect on Local Delivery of PrEP

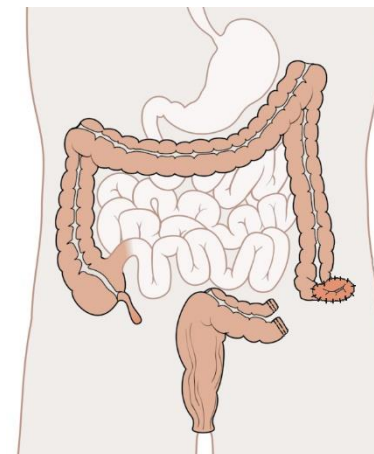
#### *Ileoanal Anastomosis*

No effect – pouch functions as new rectum



#### *Colostomy/Ileostomy*

No delivery to the rectal stump



### Conclusions

- Impact on absorption of ARVs likely to be limited
- No local delivery of oral PrEP (FTC/TDF) to the rectal stump following colostomy/ileostomy. Consider daily PrEP, rather than event-driven PrEP.