

Supplemental Digital Content 1: Inclusion and Exclusion Criteria

General Exclusion criteria

Emergency surgeries, robotic resection, incidental resections, combined procedure with HIPEC (Hyperthermic Intraperitoneal Chemotherapy).

Included procedures and Exclusion Criteria of Each Surgical Group

Cholecystectomies

Included: open and laparoscopic surgeries. Must have been main surgical procedure

Exclusion criteria: no additional to the general exclusion criteria

Colon Resections

Included: hemicolectomy left/right, resection of sigmoid colon, segmental resections, (sub)total colectomy

Exclusion criteria: cecum resection, sole colostomy, ileocolic anastomosis, appendectomy or restoration of colon continuity.

Rectum Resections

Included: anterior and low anterior rectum resection, abdominoperineal rectum resections

Exclusion criteria: procedures to extract foreign bodies

Liver Surgery

Included: wedge resection, segmental resection, hemihepatectomy right/left, atypical and central resection

Exclusion criteria: liver biopsies, abscess drainage, insertion of a pump for hepatic arterial infusion, APPLS procedure, ablation without liver resection

Pancreas Surgery

Included: Whipple procedure, left, distal and tail resection, total pancreatectomy, rest pancreatectomy, cystectomy

Exclusion criteria: necrosectomy, ablation without pancreas resection

Bariatric Surgeries

Included: open/laparoscopic gastric sleeve resection, open/laparoscopic proximal gastric bypass, open/laparoscopic distal gastric bypass, gastric bypass after previous bariatric surgery or fundoplication.

Exclusion criteria: revision or sequel procedures, such as closure of the internal hernias or distalization of the small bowel anastomosis

Liver Transplantations

Included: adult primary and re-transplantation of DCD (donation after circulatory death) and DBD (donation after brain death) organs

Exclusion criteria: living liver donor

Supplemental Digital Content 2: Center Specific Cost Compilation

In-Hospital Costs

Costs per in-hospital stay include:	University Hospital Zurich	Humanitas Research Hospital, Milan	Bellvitge University Hospital, Barcelona	Johns Hopkins School of Medicine, Baltimore	Hospital Clinic de Barcelona	University Hospital of Lyon	Curry Cabral Hospital, Lisbon
• perioperative time period: hospital admission to surgery	Yes	Yes	Yes	Yes	Yes	Yes	Yes
• Surgery costs (OR use, material used etc.)	Yes	Yes	Yes	Yes	Yes	Yes	Yes
• Rooming / food costs	Yes	Yes	Yes	Yes	Yes	Yes	Yes
• Wages of hospital staff	Yes	Yes	Yes	Cost of physician services are excluded	Yes	Yes	Yes
• Costs of drugs	Yes	Yes	Yes	Yes	Yes	Yes	Yes
• Costs of imaging (CT, MRI etc.) pre- and postoperative (executed after hospital admission)	Yes	Yes	Yes	Yes	Only preoperative imaging	Yes	Yes
• Cost of blood work	Yes	Yes	Yes	Yes	Yes	Yes	Yes
• Intervention costs (e.g. if needed for treatment or further clarification (gastroscopy, ERCP, colonoscopy etc.) pre- and postoperative (executed after hospital admission)	Yes	Yes	Yes	Yes	Yes	Yes	Yes
• Costs of treatment by another department (e.g. anesthesiology (perioperative pain adjustment etc.) or cardiology (e.g. occurrence of atrial fibrillation) etc.)	Yes	Yes	Yes	Yes	Yes	Yes	Yes
• ICU costs	Yes	Yes	Yes	Yes	Yes	Yes	Yes

OR: operation room; CT: computer tomography; MRI: magnetic resonance imaging; ERCP: endoscopic retrograde cholangiopancreatography

Costs Discharge to 3 Months postoperative

Costs occurred after hospital discharge up to 3 months postoperative include:	University Hospital Zurich	Humanitas Research Hospital, Milan	Bellvitge University Hospital, Barcelona	Johns Hopkins School of Medicine, Baltimore	Hospital Clinic de Barcelona	University Hospital of Lyon	Curry Cabral Hospital, Lisbon
• Follow up costs	<u>Some follow-ups were performed in peripheral hospitals/ general practitioner</u>	<u>Some follow-ups were performed in peripheral hospitals/ general practitioner</u>	All follow-ups were performed in <u>peripheral hospitals/ general practitioner</u> (= no follow up at center of surgery)	-	-	-	-
• Costs of readmission	Some patients were re-hospitalized in peripheral hospitals, some at the center of surgery.	Some patients were re-hospitalized in peripheral hospitals, some at the center of surgery.	All patients with the need of a re-hospitalization were always admitted to center of surgery.	-	-	-	-
• Costs of imaging (CT scans, MRI etc.)	Yes	Yes	Yes	-	-	-	-
• Cost of blood work	Yes	Yes	Yes	-	-	-	-
• Intervention costs (e.g. if needed for treatment or further clarification (gastroscopy, ERCP, colonoscopy etc.))	Yes	Yes	Yes	-	-	-	-
• Costs of complication treatment by another department	Yes	No	Yes	-	-	-	-
• Cost of postoperative chemo/radiotherapy	Yes	No	Yes	-	-	-	-
• Cost of rehabilitation center	No	No	No	-	-	-	-
• Cost of treatment in another center (peripheral hospital/general practitioner)	No	No	No	-	-	-	-
• Home care cost	No	No	No	-	-	-	-
• Physical therapy cost	No	No	No	-	-	-	-
• Cost of prescribed drugs/material	No	No	No	-	-	-	-

CT: computer tomography; MRI: magnetic resonance imaging; ERCP: endoscopic retrograde cholangiopancreatography

Supplemental Digital Content 3: Regression Equation

Coefficients	Estimate	Standard Error	Pr(> t)
Intercept	9.0794118	0.0281234	< 2e-16 ***
Age ≥ 50, < 70 years	0.1228650	0.0292660	5.06e-09 ***
Age ≥ 70 years	0.2443349	0.0403550	5.33e-11 ***
Colon surgery	0.7000556	0.0455596	< 2e-16 ***
Rectum surgery	0.9320207	0.0530560	< 2e-16 ***
Liver Surgery	0.9467566	0.0443817	< 2e-16 ***
Pancreas Surgery	1.2377483	0.0606430	< 2e-16 ***
Bariatric Surgery	0.6140153	0.0346472	< 2e-16 ***
Liver Transplantation	2.0205082	0.0644912	< 2e-16 ***
CCI®	0.0142751	0.0006457	< 2e-16 ***

Residuals:

Min	1Q	Median	3Q	Max
-1.16197	-0.22069	-0.02517	0.16689	2.02919

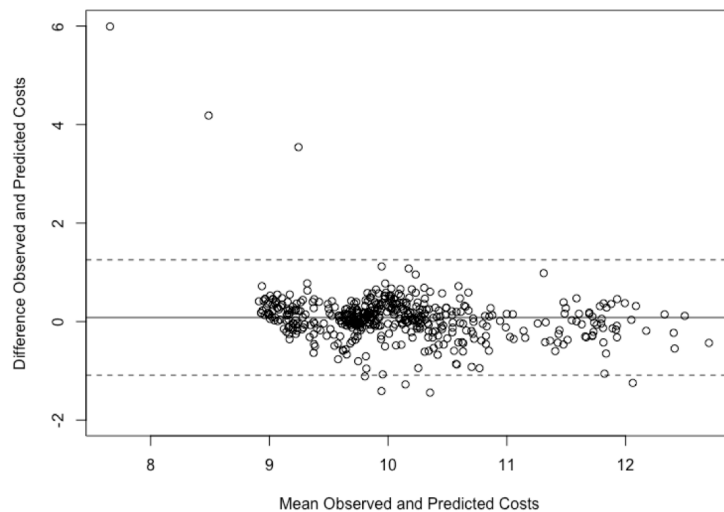
Significance codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Pr(>|t|): p-value; CCI®: Comprehensive Complication Index; Min: minimum; 1Q: first quartile; 3Q: third quartile, Max: maximum

Supplemental Digital Content 4: Bland-Altman Plot

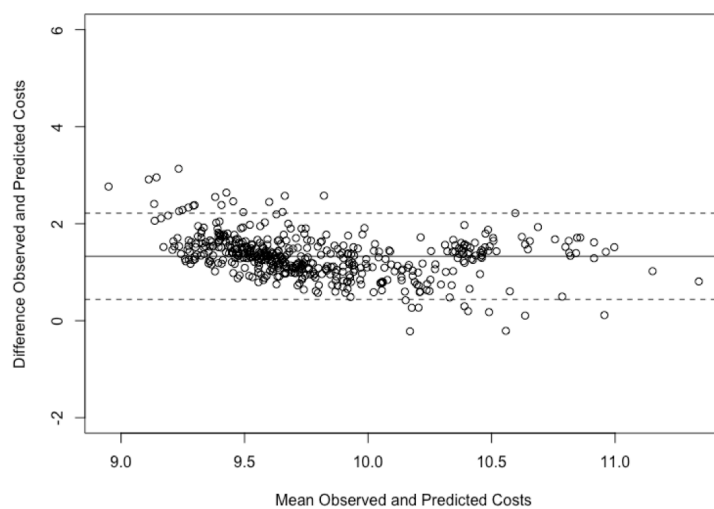
a

Zurich Validation: Range of Variation Observed to Predicted Cost



b

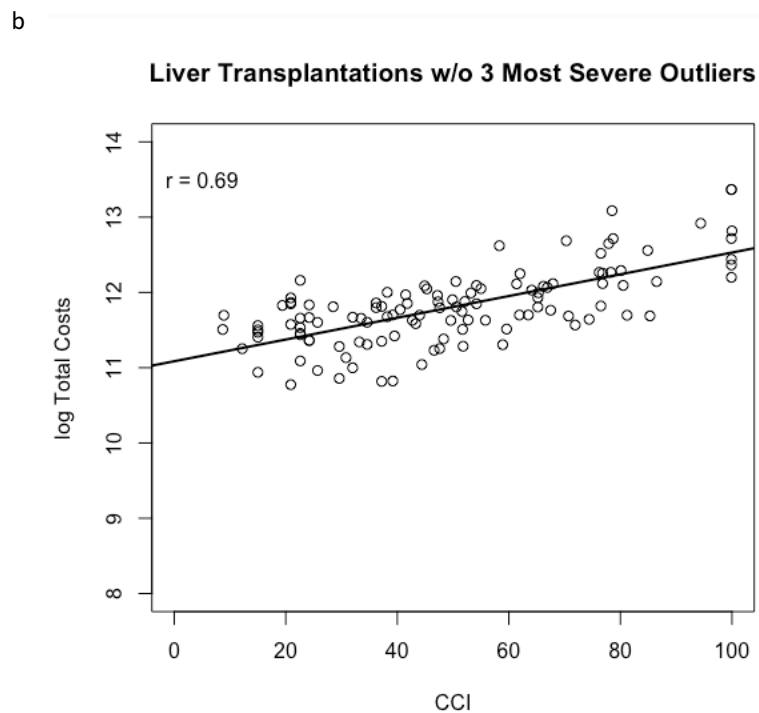
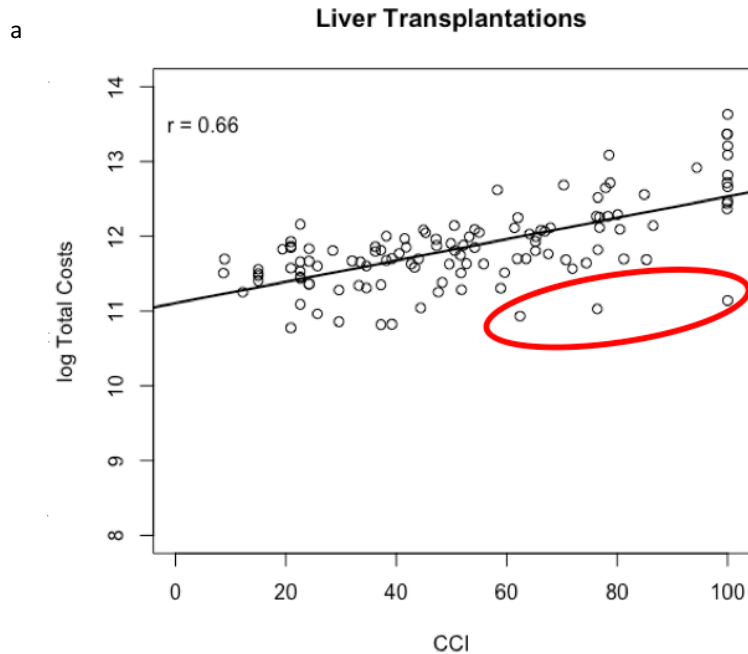
International Validation: Range of Variation Observed to Predicted Cost



SDC 4a Bland-Altman plot of the Zurich validation data showing, on average, no difference between predicted and observed cost while displaying a moderate spread (natural log).

SDC 4b Bland-Altman plot of the international data displaying a moderate spread with a 1.3 deviation in difference of the natural log of observed to predicted cost.

Supplemental Digital Content 5: Influenceability of the Correlation Coefficient by Severe Outliers



SDC 5a Scatter plot of CCI®/ cost correlation in Liver transplant patients. $R_{\text{pears}}=0.66$. The red circle marks the 3 greatest outliers.

SDC 5b Demonstration of influenceability of the correlation coefficient by extreme outliers: Solely by excluding the 3 outliers marked in a red circle in SDC 4a, the correlation coefficient increased to 0.69

Supplemental Digital Content 6

Examples of Cost Calculation by CCI[®], Age & Surgery Type

Examples	Patient 1	Patient 2	Patient 3	Patient 4	Patient 5	Patient 6	Patient 7	Patient 8
Type of Surgery	CHE	CHE	CHE	Pancreas resection	Pancreas resection	Pancreas resection	Liver transplant	Liver transplant
CCI[®] at 3 months	10	10	20	30	30	60	30	50
Age	42	52	52	52	75	75	78	78
Total Cost	\$10'096	\$11'440	\$13'160	\$52'203	\$58'859	\$89'581	\$128'656	\$170'229

SDC 6 Cost are assessed by a baseline cost (determined by surgery) to which the CCI[®] and age add to: 14% of baseline costs per 10 CCI[®] points, 12% of baseline cost for patients > 50 years, 24% of baseline cost for patients > 70 years.
CCI[®]: Comprehensive Complication Index, CHE: cholecystectomy; \$: United States dollars.

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