

COVID-19 vaccination around immune checkpoint inhibitor start and survival in a nationwide cohort of patients with cancer

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Appendix Codes.

eTable-1. Cancer and metastatic status definitions (using ICD-10). ICD-10 codes shown in **bold*** flag codes identifying metastatic cancer status.

Cancer type	International Classification of Disease. 10 th edition (ICD-10) Codes with labels
Lung/Respiratory	C33: Malignant neoplasm of trachea
	C34: Malignant neoplasm of bronchus and lung
	C39: Malignant neoplasm of other and ill-defined sites in the respiratory system and intrathoracic organs
	D021: Carcinoma in situ of trachea
	D022: Carcinoma in situ of bronchus and lung
	D023: Carcinoma in situ of other parts of respiratory system
	D024: Carcinoma in situ of respiratory system. unspecified
	D381: Neoplasm of uncertain behavior of trachea. bronchus and lung
Mesothelioma/pleural	D386: Neoplasm of uncertain behavior of respiratory system. unspecified
	C38: Malignant neoplasm of heart, mediastinum and pleura
	C45: Mesothelioma
Melanoma	D382: Neoplasm of uncertain behavior of pleura
	C43: Malignant melanoma of skin
	C69: Malignant neoplasm of eye and adnexa
Skin (malignant, other)	D03: Melanoma in situ
	C44: Other malignant neoplasms of skin
	D04: Carcinoma in situ of skin
Head and neck	C00-C14: Malignant neoplasms of lip. oral cavity and pharynx
	C30: Malignant neoplasm of nasal cavity and middle ear
	C31: Malignant neoplasm of accessory sinuses
	C32: Malignant neoplasm of larynx
	C760: Malignant neoplasm of head. face and neck of unspecified sites*
	D000: Carcinoma in situ of lip. oral cavity and pharynx
	D020: Carcinoma in situ of larynx
	D370: Neoplasm of uncertain behavior of lip. oral cavity and pharynx
Uro-vesical	D380: Neoplasm of uncertain behavior of larynx
	C65: Malignant neoplasm of renal pelvis
	C66: Malignant neoplasm of ureter
	C67: Malignant neoplasm of bladder
	C68: Malignant neoplasm of other and unspecified urinary organs
	D091: Carcinoma in situ of other and unspecified urinary organs
	D411: Neoplasm of uncertain behavior of renal pelvis
	D412: Neoplasm of uncertain behavior of ureter
	D413: Neoplasm of uncertain behavior of urethra
	D414: Neoplasm of uncertain behavior of bladder

	D417: Neoplasm of uncertain behavior of other urinary organs
	D419: Neoplasm of uncertain behavior of unspecified urinary organ
Kidney	C64: Malignant neoplasm of kidney. except renal pelvis
	D410: Neoplasm of uncertain behavior of kidney
Liver[#]	C220: Hepatocellular carcinoma
	C222: Hepatoblastoma
	C227: Other specified carcinomas of liver
	C229: Liver. unspecified
	C15: Malignant neoplasm of esophagus
	C16: Malignant neoplasm of stomach
	C17: Malignant neoplasm of small intestine
	C18: Malignant neoplasm of colon
	C19: Malignant neoplasm of rectosigmoid junction
	C20: Malignant neoplasm of rectum
	C21: Malignant neoplasm of anus and anal canal
	C26: Malignant neoplasm of other and ill-defined digestive organs
Gastro-intestinal	D001: Carcinoma in situ of esophagus
	D002: Carcinoma in situ of stomach
	D01: Carcinoma in situ of other and unspecified digestive organs
	D371: Neoplasm of uncertain behavior of stomach
	D372: Neoplasm of uncertain behavior of small intestine
	D373: Neoplasm of uncertain behavior of appendix
	D374: Neoplasm of uncertain behavior of colon
	D375: Neoplasm of uncertain behavior of rectum
	D377: Neoplasm of uncertain behavior of other digestive organs
	D379: Neoplasm of uncertain behavior of digestive system. unspecified
Breast	C50: Malignant neoplasm of breast
	D05: Carcinoma in situ of breast
	C223: Angiosarcoma of liver
	C224: Other sarcomas of liver
	C25: Malignant neoplasm of pancreas
	C221: Intrahepatic bile duct carcinoma
	C23: Malignant neoplasm of gallbladder
	C24: Malignant neoplasms of other and unspecified parts of biliary tract
Other	C37: Malignant neoplasm of thymus
	C70-C72: Malignant neoplasms of eye. brain and other parts of central nervous system
	C40: Malignant neoplasm of bone and articular cartilage of limbs
	C41: Malignant neoplasm of bone and articular cartilage. other and unspecified sites
	C46-C49: Malignant neoplasms of soft tissues
	C7A.091: Malignant carcinoid tumor of the thymus
	C73: Malignant neoplasm of thyroid gland

C74: Malignant neoplasm of adrenal gland
C75: Malignant neoplasm of other endocrine glands and related structures
C76: Malignant neoplasm of other and ill-defined sites* (<i>except C760 – see above</i>)
C77: Secondary and unspecified malignant neoplasm of lymph nodes*
C78: Secondary malignant neoplasm of respiratory and digestive organs*
C79: Secondary malignant neoplasm of other and unspecified sites*
C80: Malignant neoplasm. unspecified*
C800: Malignant neoplasm without specification of site*
C97: Malignant neoplasms of independent (primary) multiple sites*
D06: Carcinoma in situ of cervix uteri
D07: Carcinoma in situ of other and unspecified genital organs
D092: Carcinoma in situ of eye
D093: Carcinoma in situ of thyroid and other endocrine glands
D097: Carcinoma in situ of other specified sites
D099: Carcinoma in situ. unspecified
D376: Neoplasm of uncertain behavior of liver. gallbladder and biliary tract
D383: Neoplasm of uncertain behavior of mediastinum
D39: Neoplasm of uncertain behavior of female genital organs
D40: Neoplasm of uncertain behavior of male genital organs
D42: Neoplasm of uncertain behavior of meninges
D43: Neoplasm of uncertain behavior of brain and central nervous system
D44: Neoplasm of uncertain behavior of endocrine glands
D47: Neoplasm of uncertain behavior of lymphoid. haematopoietic and related tissue

* codes identifying metastatic cancer status

excluding bile-ducts cancers and liver sarcoma (grouped in other cancers)

eTable-2. Eligibility and covariate definitions (coding algorithms)

International Classification of Disease. 10 th edition (ICD-10) codes with labels of ATC (Anatomical Therapeutic Chemical) / CCAM (French Common Classification of Medical Procedures)/ NABM (French medical laboratory test/procedure nomenclature) /LPP (French list of products and services) codes and labels		
Inclusion criteria		
Anti-CTLA4		Ipilimumab : L01FX04.TREMELIMUMAB : L01FX20
Anti-PD1		Nivolumab : L01FF01. Pembrolizumab : L01FF02. Cemiplimab : L01FF06. Dostarlimab : L01FF07
Anti-PDL1		Avelumab : L01FF04. Durvalumab : L01FF03. Atezolizumab : L01FF05
Non-inclusion criteria		
Organ/bone marrow transplant^{1,2}	<p>Z94 : Transplanted organ and tissue status</p> <p>T86 : Failure and rejection of transplanted organs and tissues</p> <p>Y83.0 : Surgical operation with transplantation of a whole organ causing abnormal patient reaction or later complication. without mention of intraoperative accident</p>	<p>CCAM:</p> <p>DZEA001 : Repeat heart transplantation via thoracotomy with cardiopulmonary bypass</p> <p>DZEA002 : Orthotopic heart transplantation via thoracotomy with cardiopulmonary bypass</p> <p>DZEA003 : Heterotopic heart transplantation via thoracotomy with cardiopulmonary bypass</p> <p>DZEA004 : Heart–lung block transplantation via thoracotomy with cardiopulmonary bypass</p> <p>GFEA001 : Sequential bilateral lung transplantation via thoracotomy with cardiopulmonary bypass</p> <p>GFEA002 : Pulmonary lobe transplantation via thoracotomy with cardiopulmonary bypass</p> <p>GFEA003 : Single lung transplantation via thoracotomy without cardiopulmonary bypass</p> <p>GFEA004 : Sequential bilateral lung transplantation via thoracotomy without cardiopulmonary bypass</p> <p>GFEA005 : Pulmonary lobe transplantation via thoracotomy without cardiopulmonary bypass</p> <p>GFEA006 : Bilateral lung transplantation via thoracotomy with cardiopulmonary bypass</p> <p>GFEA007 : Single lung transplantation via thoracotomy with cardiopulmonary bypass</p> <p>HLEA001 : Total liver transplantation</p> <p>HLEA002 : Reduced-size liver transplantation</p> <p>HNEA002 : Pancreas and kidney transplantation via laparotomy</p> <p>HNEA900 : Pancreas transplantation via laparotomy</p> <p>JAFA003 : Kidney transplantation</p> <p>DZFA004 : Removal of transplanted heart graft with implantation of an internal biventricular mechanical circulatory support by thoracotomy with cardiopulmonary bypass</p> <p>HGEA005 : Small-bowel transplantation via laparotomy</p> <p>HGEA002 : Combined reduced-size liver and small-bowel transplantation via laparotomy</p> <p>HGEA004 : Combined total liver and small-bowel transplantation via laparotomy</p> <p>JAFA015 : Kidney transplantectomy by direct approach</p> <p>FELF009 Intravenous injection of a cellular therapy product for allogeneic transplantation</p> <p>GHM:</p> <p>27Z03Z Autologous hematopoietic stem cell transplants</p> <p>27Z021 Allogeneic hematopoietic stem cell transplants, level 1</p>

		27Z022 Allogeneic hematopoietic stem cell transplants, level 2 27Z023 Allogeneic hematopoietic stem cell transplants, level 3 27Z024 Allogeneic hematopoietic stem cell transplants, level 4
HIV (Human immunodeficiency virus) ³	<p>B20 : HIV disease resulting in infectious and parasitic diseases</p> <p>B21 : HIV disease resulting in malignant neoplasms</p> <p>B22 : HIV disease resulting in other specified diseases</p> <p>B23 : HIV disease resulting in other conditions</p> <p>B24 : Unspecified HIV disease</p> <p>F02.4 : Dementia in HIV disease</p> <p>Z21 : Asymptomatic HIV infection status</p>	<p>ATC:</p> <p>Nucleoside / nucleotide reverse transcriptase inhibitors (NRTIs) : J05AF01. J05AF02. J05AF03. J05AF04. J05AF06</p> <p>Non-nucleoside reverse transcriptase inhibitors (NNRTIs) : J05AG01. J05AG03. J05AG04. J05AG05. J05AG06</p> <p>Fixed-dose combinations including reverse transcriptase inhibitors : J05AR01. J05AR02. J05AR04</p> <p>Protease inhibitors (PIs) : J05AE01. J05AE02. J05AE03. J05AE04. J05AE05. J05AE07. J05AE08. J05AE09. J05AE10. J05AR10</p> <p>Other antiretroviral agents for HIV: J05AJ01. J05AJ03. J05AJ04. J05AR06. J05AR08. J05AR09. J05AR13. J05AR18. J05AR19. J05AR20. J05AR21. J05AR24. J05AR25. J05AX07. J05AX09. J05AX12. J05AX23. J05AX29. J05AX31</p> <p>GHM (French Diagnosis-Related Group-like hospital case-mix group, “<i>Groupe Homogène de Malades</i>”):</p> <p>25C02 : Procedures for HIV-related disease</p> <p>25M02 : Other HIV-related diseases</p> <p>25Z02 : HIV-related diseases</p> <p>25Z03 : HIV-related diseases (age <13 years)</p> <p>NABM:</p> <p>0805 : Genotypic resistance testing for antiretrovirals by sequencing of the reverse transcriptase and protease genes</p> <p>0806 : Genotypic resistance testing for antiretrovirals by sequencing of the envelope gene</p> <p>1691 : human leukocyte antigen B*57:01 allele testing</p> <p>4117 : Plasma concentration measurement of antiretroviral agents (limited to persons with HIV infection)</p> <p>4122 : HIV-1 viral load measurement (ribonucleic acid in plasma)</p>
Treatment/interventions		
Pneumococcal vaccination		ATC: J07AL
Any vaccine		ATC: J07
Corticosteroids		ATC: H02AB
Opioid		ATC: N02A
Antibiotics		ATC: J01
Antiepileptics		ATC: N03
Bisphosphonates		ATC: M05BA, M05BB
Anti-RANKL		ATC: M05BX04
Proton pump inhibitor		ATC: A02BC
Prior radiotherapy	Z510: Radiotherapy session	CCAM: System recording. preparation and verification before irradiation: any codes starting by ZZNL. and ZZML; and ZANL001. YYYY45-56. YYYY99. YYYY101. YYYY122. YYYY136. YYYY141. YYYY152. YYYY175. YYYY197. YYYY211. YYYY223. YYYY244. YYYY256. YYYY267. YYYY299. Y301-316. YYYY320-327. YYYY331-349. YYYY356-387. YYYY390-393. YYYY398. YYYY450. YYYY451. YYYY457-460. YYYY468-471. YYYY479-481. YYYY491-588. YYYY599. AANL001. AANL002. AZNL001.QZNL001
Prior Chemotherapy	Z511: Chemotherapy session for neoplasms	

<p>Major cancer surgery</p>	<p>CCAM: GDFA001:Hyo-thyro-epiglottectomy GDFA003:Horizontal glottectomy GDFA005:Total laryngectomy GDFA006:Vertical partial laryngectomy GDFA007:Excision of an infraglottic laryngeal lesion via laryngotomy GDFA008:Supraglottic laryngectomy extended to the base of the tongue GDFA009:Supracricoid laryngectomy with cricohyoidopexy GDFA011:Supracricoid laryngectomy with cricohyoidoepiglottopexy GDFA012:Supracricoid laryngopharyngectomy with cricohyoidopexy GDFA013:Hemilaryngopharyngectomy GDFA014:Supraglottic laryngectomy GDFA016:Anterior frontal laryngectomy with epiglottoplasty GDFA017:Supraglottic laryngopharyngectomy GDFA018:Total laryngectomy extended to the base of the tongue GFFA001:Pneumonectomy with complete pleural excision [pleuropneumonectomy], via thoracotomy GFFA002:Pneumonectomy with resection and prosthetic replacement of the superior vena cava, via thoracotomy GFFA004:Pulmonary lobectomy with bronchial resection-anastomosis or bronchial reimplantation, via thoracotomy GFFA007:Pneumonectomy with resection of adjacent organ and/or structure, via thoracotomy GFFA008:Upper pulmonary lobectomy with rib resection and brachial plexus release, via thoracotomy GFFA009:Pulmonary lobectomy, via thoracotomy with thoracoscopic preparation GFFA011:Pneumonectomy with resection-anastomosis of the tracheal bifurcation, via thoracotomy GFFA012:Pneumonectomy, via thoracotomy with thoracoscopic preparation GFFA013:Pulmonary lobectomy, via thoracotomy GFFA016:Pulmonary lobectomy with resection-anastomosis of the superior vena cava or resection of the left atrium, via thoracotomy GFFA018:Pulmonary bilobectomy, via thoracotomy GFFA019:Excision of the remaining pulmonary lobe [completion pneumonectomy], via thoracotomy GFFA022:Pulmonary lobectomy with resection of adjacent organ and/or structure, via thoracotomy GFFA023:Pulmonary bilobectomy with bronchial resection-anastomosis or bronchial reimplantation, via thoracotomy GFFA024:Pneumonectomy, via thoracotomy GFFA025:Pneumonectomy with chest wall resection, via thoracotomy GFFA026: Pulmonary lobectomy with resection-anastomosis of the tracheal bifurcation, via thoracotomy GFFA027: Pulmonary lobectomy with chest wall resection, via thoracotomy GFFA028: Pneumonectomy with resection-anastomosis of the superior vena cava or resection of the left atrium, via thoracotomy GFFA029: Single or multiple pulmonary segmentectomy, via thoracotomy GFFA030: Upper pulmonary lobectomy with rib resection and brachial plexus release, via cervicothoracotomy GFFA033: Upper pulmonary lobectomy with resection of a rib, vertebra, and subclavian vessel, excision of a cervical lymph node, and brachial plexus release, via cervicothoracotomy GFFA034: Pulmonary bilobectomy with resection of adjacent organ and/or structure, via thoracotomy GGFA001: Excision of a pleural tumor, via thoracotomy with thoracoscopic preparation GGFA003: Excision of a pleural tumor, via thoracotomy</p>
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GHFA003: Excision of a mediastinal tumor with resection of adjacent organ and/or structure, via thoracotomy

HAF001: Partial base-of-tongue glossectomy, via cervicotomy

HAF002: Non-interrupting pelvi-glosso-mandibulectomy, via an intraoral approach

HAF003: Total glossectomy of the mobile tongue, via a cervicofacial approach

HAF004: Interrupting pelvimandibulectomy, via a cervicofacial approach

HAF005: Partial excision of the base of the tongue and/or glosso-tonsillar sulcus, via an intraoral approach

HAF006: Pelviglossectomy of the mobile tongue, via an intraoral approach

HAF007: Partial oral pelvectomy, via an intraoral approach

HAF012: Total base-of-tongue glossectomy

HAF013: Total glossectomy of the mobile tongue, via an intraoral approach

HAF016: Total glossectomy with total pharyngolaryngectomy

HAF017: Interrupting pelvi-glosso-mandibulectomy, via cervicofacial approach

HAF023: Partial glossectomy of the mobile tongue, via intraoral approach

HAF024: Non-interrupting pelvimandibulectomy, via cervicofacial approach

HAF026: Non-interrupting pelvi-glosso-mandibulectomy, via cervicofacial approach

HAF027: Pelviglossectomy of the mobile tongue, via cervicofacial approach

HAF029: Total glossectomy of the base and mobile tongue

HAF033: Non-interrupting pelvimandibulectomy, via intraoral approach

HDF002: Lateral oropharyngectomy with tonsillectomy, via intraoral approach

HDF003: Total pharyngolaryngectomy extended to the base of the tongue

HDF004: Oropharyngectomy with partial non-interrupting mandibulectomy, via direct approach

HDF005: Total pharyngolaryngectomy

HDF006: Circumferential total pharyngolaryngectomy with reconstruction using retrosternal coloplasty

HDF007: Oropharyngectomy via mandibulotomy with total pharyngolaryngectomy

HDF008: Lateral oropharyngectomy, via cervicotomy

HDF009: Posterior oropharyngectomy, via intraoral approach

HDF010: Circumferential total pharyngolaryngectomy

HDF011: Oropharyngectomy with partial interrupting mandibulectomy, via cervicofacial approach

HDF012: Posterior pharyngectomy, via cervicotomy

HDF013: Oropharyngectomy with partial interrupting mandibulectomy and total pharyngolaryngectomy

HDF016: Lateral pharyngectomy, via cervicotomy

HDF017: Posterior oropharyngectomy, via cervicotomy

HDF019: Oropharyngectomy via mandibulotomy

HEFA001: Esophagectomy with esophagogastroplasty, via left thoracophrenotomy

HEFA002: Esophagectomy with esophagogastroplasty via cervicotomy, thoracotomy, and laparotomy

HEFA003: Esophagectomy with esophagogastroplasty via thoracotomy and laparoscopy

HEFA004: Total esophagectomy with esophagogastroplasty via cervicotomy and laparotomy

HEFA005: Esophagectomy with esophagojejunostomy via thoraco-phreno-laparotomy

HEFA007: Esophagectomy with esophagocoloplasty via cervicotomy, thoracotomy, and laparotomy

HEFA008: Total esophago-pharyngo-laryngectomy with esophagogastroplasty via cervicotomy and laparotomy

HEFA009: Esophagectomy with esophagocoloplasty via thoracotomy and laparotomy

HEFA011: Esophagectomy with esophagojejunostomy via thoracotomy and laparotomy

HEFA012: Esophagectomy with esophagogastroplasty via thoracotomy and laparotomy

HEFA013: Esophagectomy with esophagogastroplasty via thoraco-phreno-laparotomy

HEFA016: Esophagectomy with esophagocoloplasty via thoraco-phreno-laparotomy

HEFA018: Esophagectomy with esophagogastroplasty via cervicotomy, thoracotomy, and laparoscopy

HEFA020: Total esophagectomy without restoration of continuity via cervicotomy and laparotomy

HEFA022: Total esophagectomy without restoration of continuity via thoracotomy

HFFA002: Distal partial gastrectomy with gastroduodenal anastomosis, via laparotomy

HFFA003: Proximal partial gastrectomy with restoration of continuity, via laparotomy

HFFA005: Total gastrectomy with reconstruction, via laparotomy

HFFA006: Distal partial gastrectomy with gastrojejunostomy, via laparotomy

HFFA008: Partial re-gastrectomy with reconstruction, via laparotomy

HFFA009: Atypical partial gastric wall resection without interruption of continuity, via laparotomy

HFFC001: Atypical partial gastric wall resection without interruption of continuity, via laparoscopy

HFFC002: Distal partial gastrectomy with gastrojejunostomy, via laparoscopy

HFFC012: Distal partial gastrectomy with gastroduodenal anastomosis, via laparoscopy

HFFC017: Total gastrectomy with reconstruction, via laparoscopy

HHFA002: Left colectomy with mobilization of the splenic flexure and restoration of continuity, via laparoscopy or laparotomy with laparoscopic preparation

HHFA004: Total colectomy with rectal preservation and ileorectal anastomosis, via laparoscopy or laparotomy with laparoscopic preparation

HHFA005: Total colectomy with rectal preservation without restoration of continuity, via laparoscopy or laparotomy with laparoscopic preparation

HHFA006: Left colectomy with mobilization of the splenic flexure and restoration of bowel continuity, via laparotomy

HHFA008: Right colectomy with restoration of bowel continuity, via laparoscopy or laparotomy with laparoscopic preparation

HHFA009: Right colectomy with restoration of bowel continuity, via laparotomy

HHFA010: Left colectomy without splenic flexure mobilization with restoration of bowel continuity, via laparoscopy or laparotomy with laparoscopic preparation

HHFA014: Left colectomy without splenic flexure mobilization without restoration of continuity, via laparotomy

HHFA017: Left colectomy without splenic flexure mobilization with restoration of bowel continuity, via laparotomy

HHFA018: Transverse colectomy, via laparotomy

HHFA021: Total colectomy with rectal preservation without restoration of continuity, via laparotomy

HHFA022: Total colectomy with rectal preservation and ileorectal anastomosis, via laparotomy

HHFA023: Transverse colectomy, via laparoscopy or laparotomy with laparoscopic preparation

HHFA024: Left colectomy with splenic flexure mobilization without restoration of continuity, via laparotomy

HHFA026: Right colectomy without restoration of continuity, via laparotomy

HHFA028: Total proctocolectomy with ileoanal anastomosis, via laparoscopy or laparotomy with laparoscopic preparation

HHFA029: Total proctocolectomy without restoration of continuity, via laparoscopy or laparotomy with laparoscopic preparation
 HHFA030: Total proctocolectomy without restoration of continuity, via laparotomy
 HHFA031: Total proctocolectomy with ileoanal anastomosis, via laparotomy
 HHFC040: Left colectomy without splenic flexure mobilization and without restoration of continuity, via laparoscopy
 HHFC296: Right colectomy without restoration of continuity, via laparoscopy
 HJFA001: Rectocolic resection with retrorectal colonic pull-through via laparotomy and colorectal anastomosis through the anal approach
 HJFA002: Rectosigmoid resection with infraperitoneal colorectal anastomosis, via laparotomy
 HJFA003: Excision of rectal tumor via transsphincteric approach
 HJFA004: Rectosigmoid resection with infraperitoneal colorectal anastomosis, via laparoscopy or laparotomy with laparoscopic preparation
 HJFA005: Abdominoperineal resection of the rectum via perineal approach
 HJFA006: Rectosigmoid resection via laparotomy with coloanal anastomosis through the anal or transsphincteric approach
 HJFA017: Rectosigmoid resection via laparoscopy or laparotomy with laparoscopic preparation and coloanal anastomosis via the anal approach
 HJFA019: Abdominoperineal resection via laparoscopy or laparotomy with laparoscopic preparation and perineal approach
 HKFA007: Excision of malignant tumor of the anal canal and/or anus
 HLFA003: Caudate lobe (segment I) liver resection, via laparotomy
 HLFA004: Extended right hepatectomy including caudate lobe (segment I), via laparotomy
 HLFA005: Right hepatic lobectomy (right hepatectomy extended to segment IV), via laparotomy
 HLFA006: Hepatic trisegmentectomy, via laparotomy
 HLFA007: Extended left hepatectomy including caudate lobe (segment I), via laparotomy
 HLFA009: Hepatic bisegmentectomy, via laparotomy
 HLFA010: Central hepatectomy, via laparotomy
 HLFA011: Left hepatic lobectomy, via laparotomy
 HLFA017: Right hepatectomy, via laparotomy
 HLFA018: Left hepatectomy, via laparotomy
 HLFA019: Atypical liver resection, via laparotomy
 HLFA020: Hepatic segmentectomy (single segment), via laparotomy
 HLFC002: Left hepatic lobectomy, via laparoscopy
 HLFC003: Atypical liver resection, via laparoscopy
 HLFC004: Hepatic segmentectomy (single segment), via laparoscopy
 HLFC027: Hepatic bisegmentectomy, via laparoscopy
 HLFC032: Hepatic trisegmentectomy, via laparoscopy
 HLFC037: Left hepatectomy, via laparoscopy
 HNFA001: Pancreatic isthmectomy with reconstruction of pancreatic duct continuity, via laparotomy
 HNFA002: Distal pancreatectomy with spleen preservation and pancreaticojejunostomy, via laparotomy
 HNFA004: Total duodenopancreatectomy with splenectomy, via laparotomy
 HNFA006: Total or subtotal pancreatectomy with duodenal preservation and splenectomy, via laparotomy
 HNFA007: Pancreaticoduodenectomy (Whipple procedure), via laparotomy
 HNFA008: Distal pancreatectomy with spleen preservation, via laparotomy
 HNFA010: Distal pancreatectomy with splenectomy and pancreaticojejunostomy, via laparotomy
 HNFA011: Total or subtotal pancreatectomy with duodenal preservation without splenectomy, via laparotomy
 HNFA013: Distal pancreatectomy with splenectomy, via laparotomy

HNFC002: Distal pancreatectomy with splenectomy, via laparoscopy
 HNFC028: Distal pancreatectomy with spleen preservation, via laparoscopy
 JAF001: Heminephrectomy with partial ureterectomy, via open approach
 JAF002: Total nephrectomy via lumbotomy
 JAF003: Heminephrectomy with total ureterectomy, via open approach
 JAF005: Extended total nephrectomy with lateral resection of the inferior vena cava, via open approach
 JAF006: Ex situ partial nephrectomy with renal autotransplantation
 JAF008: Partial nephrectomy with vascular pedicle dissection, via lumbotomy
 JAF009: Extended nephrectomy including renal fossa, via laparotomy or lomboabdominal approach
 JAF010: Unilateral total nephrectomy via vertical lumbar approach
 JAF011: Extended nephrectomy with caval thrombectomy and intra-atrial control via thoraco-phreno-laparotomy
 JAF012: Total nephrectomy via laparotomy with retrograde endoscopic ureteral extraction
 JAF014: Extended nephrectomy with caval thrombectomy via laparotomy
 JAF016: Bilateral nephrectomy via laparotomy
 JAF019: Partial nephrectomy with vascular pedicle dissection, via laparotomy
 JAF021: Extended nephrectomy with adrenalectomy via thoraco-phreno-laparotomy
 JAF022: Extended nephrectomy with caval thrombectomy via thoraco-phreno-laparotomy
 JAF023: Unilateral total nephrectomy via laparotomy
 JAF024: Partial nephrectomy without vascular pedicle dissection via lumbotomy
 JAF025: Extended nephrectomy with adrenalectomy and caval thrombectomy
 JAF027: Bilateral nephrectomy via bilateral lumbar approaches
 JAF028: Extended nephrectomy with adrenalectomy and caval thrombectomy via laparotomy
 JAF029: Extended nephrectomy with adrenalectomy via laparotomy
 JAF030: Partial nephrectomy without vascular pedicle dissection via laparotomy
 JAF031: Extended total nephrectomy including the renal fossa, via thoraco-phreno-laparotomy
 JAF032: Total nephroureterectomy, via open approach
 JAF001: Total nephroureterectomy, via laparoscopy or retroperitoneoscopy
 JAF002: Heminephrectomy with partial ureterectomy, via laparoscopy or retroperitoneoscopy
 JAF004: Bilateral nephrectomy, via laparoscopy or retroperitoneoscopy
 JAF005: Partial nephrectomy, via laparoscopy or retroperitoneoscopy
 JAF006: Unilateral total nephrectomy, via laparoscopy or retroperitoneoscopy
 JAF007: Heminephrectomy with total ureterectomy, via laparoscopy or retroperitoneoscopy
 JAF010: Extended total nephrectomy including the renal fossa with adrenalectomy, via laparoscopy or retroperitoneoscopy
 JAF019: Extended total nephrectomy including the renal fossa, via laparoscopy or retroperitoneoscopy
 JCF001: Total ureterectomy, via open approach
 JDF001: Total cystectomy with cutaneous ureterostomy, via laparotomy
 JDF003: Total cystectomy with continent transintestinal cutaneous ureterostomy using a detubularized loop, via laparotomy
 JDF005: Total cystectomy, via laparotomy
 JDF006: Total cystectomy with ureterocolic anastomosis and creation of a detubularized rectosigmoid or ileorectosigmoid reservoir, via laparotomy
 JDF008: Total cystectomy with transintestinal cutaneous ureterostomy using a non-detubularized loop, via laparotomy
 JDF009: Total cystectomy with direct ureterocolic anastomosis, via laparotomy
 JDF011: Partial cystectomy, via laparotomy

JDFA014: Partial cystectomy with implantation of material for interstitial bladder irradiation, via laparotomy
 JDFA015: Supratrigonal cystectomy with detubularized augmentation enterocystoplasty and ureterovesical reimplantation, via laparotomy
 JDFA016: Total cystectomy with orthotopic replacement enterocystoplasty [neobladder] using a detubularized loop, via laparotomy
 JDFA017: Partial cystectomy with ureterovesical reimplantation, via laparotomy
 JDFA019: Total vesiculoprostatocystectomy with direct ureterocolic anastomosis, via laparotomy
 JDFA020: Total vesiculoprostatocystectomy with continent transintestinal cutaneous ureterostomy using a detubularized loop, via laparotomy
 JDFA021: Total vesiculoprostatocystectomy with orthotopic replacement enterocystoplasty [neobladder] using a detubularized loop, via laparotomy
 JDFA022: Total vesiculoprostatocystectomy with ureterocolic anastomosis and creation of a detubularized rectosigmoid or ileorectosigmoid reservoir, via laparotomy
 JDFA023: Total vesiculoprostatocystectomy with cutaneous ureterostomy, via laparotomy
 JDFA024: Total vesiculoprostatocystectomy, via laparotomy
 JDFA025: Total vesiculoprostatocystectomy with transintestinal cutaneous ureterostomy using a non-detubularized loop, via laparotomy
 JDFA023: Partial cystectomy, via laparoscopy
 JFFA001: Anterior pelvic exenteration with cutaneous ureterostomy, via laparotomy
 JGFC001: Total vesiculoprostatectomy, via laparoscopy
 QEFA001: Breast lumpectomy with axillary lymph node dissection
 QEFA003: Total mastectomy with axillary and parasternal [internal mammary] lymph node dissection
 QEFA004: Breast lumpectomy
 QEFA005: Total mastectomy with resection of the pectoral muscles and axillary lymph node dissection
 QEFA007: Subcutaneous mastectomy with excision of the nipple-areola complex
 QEFA008: Partial mastectomy with axillary lymph node dissection
 QEFA010: Total mastectomy with axillary and supraclavicular lymph node dissection
 QEFA013: Total mastectomy with extended skin resection, with pedicled latissimus dorsi flap or parascapular flap
 QEFA019: Total mastectomy
 QEFA020: Total mastectomy with preservation of the pectoral muscles and axillary lymph node dissection
 QZFA001: Excision of 2 to 5 suprafascial subcutaneous lesions measuring less than 3 cm in greatest dimension
 QZFA002: Excision of one suprafascial subcutaneous lesion measuring less than 3 cm in greatest dimension
 QZFA003: Excision of a superficial skin lesion involving 6 or more skin areas, each less than 5 cm²
 QZFA004: Excision of a superficial skin lesion involving one skin area of 5 to 10 cm²
 QZFA005: Excision of 6 or more suprafascial subcutaneous lesions measuring less than 3 cm in greatest dimension
 QZFA007: Excision of a suprafascial subcutaneous lesion measuring 3 to 10 cm in greatest dimension
 QZFA008: Excision of a superficial skin lesion involving one skin area of less than 5 cm², using chemosurgical technique [Mohs technique]
 QZFA011: Excision of a superficial skin lesion involving one skin area of 10 to 50 cm²
 QZFA020: Partial or total excision of the nail plate
 QZFA024: Excision of a suprafascial subcutaneous lesion measuring more than 10 cm in greatest dimension

		<p>QZFA026: Excision of a superficial skin lesion involving one skin area larger than 10 cm², using chemosurgical technique [Mohs technique]</p> <p>QZFA030: Excision of a superficial skin lesion involving one skin area larger than 200 cm²</p> <p>QZFA033: Excision of a superficial skin lesion involving one skin area of 5 to 10 cm², using chemosurgical technique [Mohs technique]</p> <p>QZFA035: Excision of a superficial skin lesion involving one skin area of 50 to 200 cm²</p> <p>QZFA036: Excision of a superficial skin lesion involving one skin area of less than 5 cm²</p> <p>QZFA039: Partial excision of the nail apparatus</p>
Anti-angiogenics		<p>AFLIBERCEPT (L01XX44), AXITINIB (L01EK01), BEVACIZUMAB (L01FG01), CABOZANTINIB (L01EX07), LENVATINIB (L01EX08), NINTEDANIB (L01EX09), PAZOPANIB (L01EX03), RAMUCIRUMAB (L01FG02), REGORAFENIB (L01EX05), RIPRETINIB (L01EX19), SORAFENIB (L01EX02), SUNITINIB (L01EX01), VANDETANIB (L01EX04), CEDIRANIB (L01EK02)</p>
Other covariates		
Home oxygen use		<p>Reimbursement LP P codes for long-term or short-term oxygen therapy, including fixed or ambulatory oxygen delivery, oxygen concentrators, liquid oxygen, and oxygen therapy combined with assisted ventilation, tracheostomy care, or insufflation/exsufflation devices: 9982186,1190161,1190623,1191568,1192119, 1195520,1195810,1195885,1196880,9972845,1161113,1162035,1162437, 1149106,1149394,1151161,1151942,1133430,1167890,1167937,1169304, 1143470,1143983,1144468,1114645,1116680,1116880,1182612,1184315, 1132270,1107579,1107763,1107800,2590023,2593257,1171790,1198547, 1171614,9903293,9903904,9913096,1158329,1158335,1158737,4987500, 1186685,1188098,1150635,1177663,1178540,1178651,9935809,9937381, 9962344,9962440,1135392,1136227,1118324,1119789,1119826,1120338, 1163916,1163951,1165938,1165944,1165967,1166820,1160817,1161060, 9945334,9946606,1174133,1175380,1175440,1128771,1128104,1136581, 1138315,1138953,1112050,1188885,1103720,1105184,1105416,1105528, 1125100,1125181,1125287,1125790,1125873,1126401,1126708,1172967, 1173560,1132442,1130220,9921799,1100229,1101950,1102464,1103297, 1121421,1122053,1123242,1123609,1144936,1145404,145723,1146444, 1148130.</p>
Palliative care	Z515: Palliative care	
Obesity ⁴	<p>E66.0 : Obesity due to excess calories.</p> <p>E66.1 : Drug-induced obesity.</p> <p>E66.2 : Extreme obesity with alveolar hypoventilation.</p> <p>E66.8 : Other obesity.</p> <p>E66.9 : Obesity. unspecified.</p>	<p>CCAM:</p> <p>HFCA001 : Gastric bypass with Roux-en-Y reconstruction for morbid obesity. by laparotomy</p> <p>HFCC003 : Gastric bypass with Roux-en-Y reconstruction for morbid obesity. by laparoscopy</p> <p>HFFA001 : Gastrectomy with biliopancreatic or intestinal bypass for morbid obesity. by laparotomy</p> <p>HFFA011 : Sleeve gastrectomy for morbid obesity. by laparotomy</p> <p>HFCC004 : Gastrectomy with biliopancreatic or intestinal bypass for morbid obesity. by laparoscopy</p> <p>HFFC018 : Sleeve gastrectomy for morbid obesity. by laparoscopy</p> <p>HFGC900 : Removal of a gastric wall stimulation lead for morbid obesity. by laparoscopy</p> <p>HFKA001 : Change or repositioning of the access port of an adjustable gastric band for morbid obesity</p> <p>HFKA002 : Replacement of an adjustable gastric band for morbid obesity. by laparotomy</p> <p>HFKC001 : Replacement of an adjustable gastric band for morbid obesity. by laparoscopy</p> <p>HFLC900 : Subcutaneous implantation of a gastric stimulator with placement of a gastric wall lead for morbid obesity</p>

	<p>HFLE002 : Placement of an intragastric balloon for morbid obesity. by esophagogastroduodenoscopy</p> <p>HFMA009 : Gastroplasty with placement of an adjustable gastric band for morbid obesity. by laparotomy</p> <p>HFMA010 : Vertical banded gastroplasty for morbid obesity. by laparotomy</p> <p>HFMA011 : Repositioning or removal of an adjustable gastric band for morbid obesity. by laparotomy</p> <p>HFMC006 : Vertical banded gastroplasty for morbid obesity. by laparoscopy</p> <p>HFMC007 : Gastroplasty with placement of an adjustable gastric band for morbid obesity. by laparoscopy</p> <p>HFMC008 : Repositioning or removal of an adjustable gastric band for morbid obesity. by laparoscopy</p> <p>HGCA009 : Biliopancreatic or intestinal bypass for morbid obesity. by laparotomy</p> <p>HGCC027 : Biliopancreatic or intestinal bypass for morbid obesity. by laparoscopy</p>
Malnutrition	<p>E43: Unspecified severe protein-energy malnutrition</p> <p>E44.0: Moderate protein-energy malnutrition</p> <p>E44.1: Mild protein-energy malnutrition</p> <p>E46: Unspecified protein-energy malnutrition</p>
Heart failure⁴	<p>I50 : Heart failure</p> <p>I11: Hypertensive heart disease</p> <p>I11.0: Hypertensive heart disease with (congestive) heart failure</p> <p>I13: Hypertensive heart and renal disease</p> <p>I13.0: Hypertensive heart and renal disease with (congestive) heart failure</p> <p>I13.2: Hypertensive heart and renal disease with both (congestive) heart failure and renal failure</p> <p>I13.9: Hypertensive heart and renal disease, unspecified</p>
Low income	Entitlement to complementary universal health coverage (CMU-C or, since 2019, Complémentaire Santé Solidaire [CSS]), a proxy for low socioeconomic status in the SNDS
Deprivation index⁵	A territorial index of social to characterize the socioeconomic environment of beneficiaries based on their municipality of residence.
Hypertension³	<p>ATC: ≥3 dispensing per year in ATC: Clonidine (C02AB02), Hydrochlorothiazide (C03AA01), Spironolactone (C03DA01), Metoprolol (C07AA12), Atenolol (C07AB08), Carvedilol (C07DA06), Amlodipine (C08CA09), Lisinopril (C09AA03), Zofenopril (C09AA15), Fosinopril and diuretics (C09BA09), Valsartan (C09CA03), Candesartan and diuretics (C09DA06), Methyldopa (C02AC01), Chlorothiazide (C03AA03), Amiloride (C03DB01), Bisoprolol (C07AA15), Nebivolol (C07AB12), Propranolol and diuretics (C07FB02), Lercanidipine (C08CA11), Perindopril (C09AA04), Imidapril (C09AA16), Zofenopril and diuretics (C09BA15), Irbesartan (C09CA04), Telmisartan and diuretics (C09DA07), Guanfacine (C02AC02), Chlortalidone (C03BA04), Low-ceiling diuretics and potassium-sparing agents (C03EA), Esmolol (C07AA16), Labetalol (C07AG01), Metoprolol and diuretics</p> <p>I10: Essential (primary) hypertension</p> <p>I11: Hypertensive heart disease</p> <p>I12: Hypertensive renal disease</p> <p>I13: Hypertensive heart and renal disease</p>

		(C07FB03), Nifedipine (C08CA13), Ramipril (C09AA05), Captopril and diuretics (C09BA01), Enalapril and lercanidipine (C09BB02), Candesartan (C09CA06), Olmesartan medoxomil and diuretics (C09DA08), Moxonidine (C02AC05), Indapamide (C03BA10), Hydrochlorothiazide and amiloride (C03EA01), Betaxolol (C07AA23), Propranolol and thiazides (C07BA02), Verapamil (C08CA01), Diltiazem (C08CX01), Quinapril (C09AA06), Enalapril and diuretics (C09BA02), Perindopril and amlodipine (C09BB04), Telmisartan (C09CA07), Valsartan and amlodipine (C09DB01), Rilmenidine (C02AC06), Metolazone (C03BA11), Bendroflumethiazide and potassium-sparing agents (C03EA04), Pindolol (C07AB02), Metoprolol and thiazides (C07BB02), Diltiazem (C08CA02), Verapamil and diuretics (C08DA01), Benazepril (C09AA07), Lisinopril and diuretics (C09BA03), Ramipril and amlodipine (C09BB07), Olmesartan medoxomil (C09CA08), Olmesartan medoxomil and amlodipine (C09DB02), Doxazosin (C02CA01), Torasemide (C03BX03), Propranolol (C07AA02), Nadolol (C07AB03), Atenolol and diuretics (C07BB03), Amlodipine (C08CA03), Verapamil and thiazides (C08DB01), Cilazapril (C09AA08), Perindopril and diuretics (C09BA04), Perindopril and bisoprolol (C09BB10), Losartan (C09DA01), Valsartan and hydrochlorothiazide (C09DB04), Prazosin (C02CA06), Bumetanide (C03CA01), Acebutolol (C07AA03), Oxprenolol (C07AB04), Bisoprolol and hydrochlorothiazide (C07BB07), Felodipine (C08CA04), Nitrendipine (C08GA02), Moexipril (C09AA09), Trandolapril and verapamil (C09BA05), Olmesartan medoxomil and hydrochlorothiazide (C09BX02), Eprosartan and hydrochlorothiazide (C09DA02), Azilsartan medoxomil (C09XA02), Reserpine combinations (C02DC01), Furosemide (C03CA02), Sotalol (C07AA05), Bisoprolol and amlodipine (C07AB05), Metoprolol and felodipine (C07BB12), Amlodipine and perindopril (C08CA05), Amlodipine and benazepril (C09AA01), Enalapril and hydrochlorothiazide (C09AA10), Enalapril and felodipine (C09BA06), Losartan and hydrochlorothiazide (C09CA01), Telmisartan and amlodipine (C09DA03), Azilsartan medoxomil and chlorthalidone (C09XA52), Urapidil (C02LA01), Bumetanide and potassium-sparing agents (C03CA03), Timolol (C07AA06), Carteolol (C07AB07), Nebivolol and hydrochlorothiazide (C07CA03), Lacidipine (C08CA08), Enalapril (C09AA02), Enalapril and lercanidipine (C09AA13), Lisinopril and hydrochlorothiazide (C09BA07), Losartan and amlodipine (C09CA02), Irbesartan and amlodipine (C09DA04), Rosuvastatin and valsartan (C10BX03)
Diabetes³	E10 : Type 1 diabetes mellitus E11 : Type 2 diabetes mellitus E12 : Malnutrition-related diabetes mellitus E13 : Other specified diabetes mellitus E14 : Unspecified diabetes mellitus	ATC: ≥3 dispensing per year in ATC level 2 class A10; or ≥2 dispensing per year (in the case of large pack sizes); except for Benfluorex: A10BX06, SGLT-2 (sodium–glucose cotransporter 2) inhibitors: A10BK, A10BD16, A10BD19, A10BD21, A10BD23, A10BD24, A10BD25, GLP-1 (glucagon-like peptide-1) analogues: A10BJ. Only include: SGLT-2 in combination with metformin: A10BD15, A10BD20 Specific SGLT-2 inhibitors: CIP13 3400927892912 (Jardiance® 25 mg), 3400927672897 (Invokana® 100 mg), 3400927672958 (Invokana® 300 mg) GLP-1 (glucagon-like peptide-1) analogues in combination with insulin: ATC A10AE56 Specific GLP-1 analogues: ATC A10BJ01. A10BJ02. A10BJ05. A10BJ06
Respiratory failure	J96 : Respiratory failure. not elsewhere classified	
Chronic obstructive pulmonary disease or emphysema	J43 : Emphysema J44 : Other chronic obstructive pulmonary disease	
COVID-19 infection*	U071: COVID-19, virus identified	
Pulmonary embolism	I26 : Pulmonary embolism	

Femoral neck fracture	S720: Fracture of neck of femur
Cataract surgery⁶	<p>CCAM:</p> <p>BFGA002 : Manual extracapsular cataract extraction with implantation of an artificial intraocular lens in the posterior chamber of the eye</p> <p>BFGA004 : Extracapsular cataract extraction by phacoemulsification with implantation of an artificial intraocular lens in the posterior chamber of the eye</p> <p>BFGA427 : Extracapsular cataract extraction by phacoemulsification with implantation of an artificial intraocular lens in the posterior chamber of the eye, without trabecular drainage</p> <p>BFGA368 : Extracapsular cataract extraction by phacoemulsification with implantation of an artificial intraocular lens in the posterior chamber of the eye, with ab interno trabecular drainage</p> <p>BFGA006 : Intracapsular or extracapsular cataract extraction with implantation of an artificial intraocular lens in the anterior chamber when implantation in the posterior chamber is not possible</p> <p>BFLA001 : Secondary implantation of an unsutured artificial intraocular lens</p> <p>BFLA003 : Secondary implantation of a sutured artificial intraocular lens</p> <p>BFLA004 : Secondary implantation of an artificial intraocular lens in a pseudo phakic eye</p> <p>BFGA001 : Extraction of a dislocated crystalline lens</p> <p>BFGA003 : Manual extracapsular cataract extraction without implantation of an artificial intraocular lens</p> <p>BFGA007 : Extraction of a subluxated or ectopic crystalline lens</p> <p>BFGA008 : Extracapsular cataract extraction by phacoemulsification without implantation of an artificial intraocular lens</p> <p>BFGA009 : Intracapsular cataract extraction without implantation of an artificial intraocular lens</p> <p>BFGA010 : Lens extraction by posterior sclerotomy (pars plana) [phacophagy]</p> <p>BFPA002 : Capsulotomy or partial/total excision of residual lens capsule by keratotomy</p> <p>BFPA001 : Corneal capsulotomy for secondary cataract using laser</p> <p>BFPP001 : Lens capsulotomy for secondary cataract using laser</p> <p>BFEA001 : Repositioning of an artificial intraocular lens</p> <p>BFGA001 : Replacement of implanted material in the anterior segment of the eye</p> <p>BFGA005 : Removal of implanted material from the anterior segment of the eye</p>
Acute Cholecystitis	K810: Acute cholecystitis

Abbreviations: anti-CTLA4: anti-cytotoxic T-lymphocyte-associated protein 4; Anti-PD1: anti-programmed cell death protein 1; Anti-PDL1: anti-programmed death-ligand 1; CIP13: 13-digit French drug presentation identifier (“Code Identifiant de Présentation”) ; LPP: “Liste des produits et prestations” in the French reimbursement system, it is the nomenclature for medical devices and related services/products reimbursed ; RANKL (Receptor Activator of Nuclear FactorB Ligand, specifically denosumab)

* COVID-19 infection was defined as a hospitalization with the corresponding ICD-10 diagnosis code and/or a positive SARS-CoV-2 test recorded in SI-DEP (Système d’Information de Dépistage) within the SNDS.COVID-19 vaccination was identified using SI-VAC (Système d’Information Vaccin Covid) within the SNDS (Système National des Données de Santé).

¹ Dufour E, Bertrand M, Botton J, Cuenot F, Dray-Spira R, Weill A, Zureik M.. Recours à l’oxygénothérapie à domicile pour une infection à SARS-CoV-2 en 2021 [Internet]. Saint-Denis (FR) : EPI-PHARE; 19 Oct 2022 [cited 2025 Jan 8]. Available from: https://www.epi-phare.fr/app/uploads/2022/10/epi-phare_rapport_oxygenotherapie.pdf

²Leleu X, Gorsh B, Bessou A, Paka P, De Nascimento J, Colin X, et al. Survival outcomes for patients with multiple myeloma in France: a retrospective cohort study using the Système National des Données de Santé national healthcare database. Eur J Haematol. 2023;111(1):125–134. doi:10.1111/ejh.13976.

³ Gastaldi-Ménager C. The “cartographie” tool (CNAM, France). Eur J Public Health. 2019;29(Suppl 4):ckz185.108. Accessed February 2025.

⁴Dufour E, Herlemont P, Zureik M. Stents et ballons utilisés dans l'artériopathie oblitérante des membres inférieurs (AOMI) en France entre 2017 et 2019 : étude menée à partir des données du SNDS. Saint-Denis (FR): EPI-PHARE; 2021 Mar [cited 2025 Jan 8]. Available from: https://www.epi-phare.fr/app/uploads/2021/03/epi-phare_rapport_utilisationdm_paclitaxel_202103.pdf

⁵Rey G, Jouglu E, Fouillet A, Hemon D, et al. Ecological association between a deprivation index and mortality in France over the period 1997–2001: variations with spatial scale, degree of urbanicity, age, gender and cause of death. *BMC Public Health*. 2009;9:33. doi:10.1186/1471-2458-9-33.

⁶ Dufour E, Baheux C, Zureik M. État des lieux de cinq interventions courantes impliquant des dispositifs médicaux implantables : conséquences liées au Covid-19 en France en 2020 et de janvier à avril 2021. Étude menée à partir des données du SNDS. Saint-Denis: EPI-PHARE (ANSM-CNAM); 2021 Sep 29 Mar [cited 2026 Jun 4]. Available from: https://www.epi-phare.fr/app/uploads/2021/09/epi-phare_rapport_covid_chirurgie_20210929.pdf

eTable-3. pre-ICI COVID-19 mRNA vaccination (≤100 days before ICI initiation) study details

Elements	Study description
Design	Observational retrospective cohort study
Objective	To estimate the effect of receiving ≥1 dose of a COVID-19 mRNA vaccine within the 100 days before ICI initiation on subsequent mortality in adult cancer patients.
Eligibility criteria	Adults aged ≥18 years with a cancer diagnosis initiating ICI (anti-PD1, anti-PDL1 or anti-CTLA4) between 28 December 2020 and 22 March 2023, during the period with complete COVID-19 vaccination recording in the SNDS.
Exclusion Criteria	History of solid organ transplantation or hematopoietic stem-cell transplantation; HIV infection; <3 years of observable SNDS history before ICI initiation; receipt of mixed COVID-19 vaccine schedules or only non-mRNA COVID-19 vaccines within the 100 days before ICI initiation.
Treatment strategies	1/ ≥1 dose of COVID-19 mRNA vaccine within 100 days before the first ICI administration. 2/ No COVID-19 vaccine within 100 days before the first ICI administration
Treatment assignment	Propensity score-based inverse probability of treatment weighting (IPTW) using baseline covariates* measured at (or before) ICI initiation; covariate balance assessed after weighting (e.g., standardized mean differences).
Outcomes	Primary: all-cause mortality Secondary: cancer death and non-COVID-19 death (cause-of-death analyses restricted to deaths occurring through 31 December 2023 because cause-of-death data were not available for 2024); real-world Progression Free Survival (rwPFS).
Follow-up[#]	Starts at ICI initiation (time zero) and ends at death or administrative censoring (31 December 2024 for all-cause mortality; 31 December 2023 for cause-specific deaths analyses), whichever occurs first.
Causal contrasts	Observational analog of an intention-to-treat effect estimated using IPTW-weighted analyses.
Statistical analysis	IPTW-weighted Cox proportional hazards models for overall survival. For cancer and non-COVID-19 death: IPTW-weighted cause-specific Cox models and IPTW-weighted Fine-Gray sub-distribution hazard models (treating other causes of death as a competing event). IPTW-weighted Cox proportional hazards models for rwPFS.

*List of covariates included in the models: age, sex, low-income status, deprivation index, region of residence, primary tumor site, a proxy for metastatic disease (presence of metastasis codes), the type of ICI regimen (anti-PD1, anti-PDL1, or anti-PD1+anti-CTLA4), calendar year of ICI initiation, cancer radiotherapy in the 3 years, chemotherapy in the last 3 years, major cancer surgeries in the last 3 years, proxy of performance status, volume of inclusion in the center, anti-angiogenic therapy in the last 3 months, cancer-related frailty variables such as malnutrition, at least 2 ambulance transports on separate days, at least 1 emergency department visit, at least 1 intensive care unit admission, at least 1 hospitalization in a rehabilitation or long-term care facility, at least 1 at-home hospitalization, at least 1 home nursing care visit, use of home oxygen therapy, and at least 1 palliative care stay in the last 6 months, baseline treatments such as opioids, antibiotics, antiepileptics, bisphosphonates, anti-RANKL (receptor activator of nuclear factor kappa-B ligand) agents, proton pump inhibitors, and corticosteroids (defined as at least 7 mg/day prednisone) in the last 3 months, number of general practitioner consultations in the previous 6 months, receipt of any non-COVID vaccination within 1 year before ICI initiation and other comorbidities such as respiratory failure, chronic obstructive pulmonary disease or emphysema, heart failure, hypertension, diabetes and obesity in the past 2 years.

[#]Dates of death (all-cause mortality) were available through December 31, 2024, whereas cause of death was available through December 31, 2023; accordingly, all-cause survival analyses were administratively censored on December 31, 2024, and cause-specific/competing-risk analyses on December 31, 2023.

e-Table 4. Target trial emulation design for post-ICI COVID-19 mRNA vaccination

Elements	Target trial	Target trial emulation
Design	Open-label multicenter two parallel arm superiority randomized trial	Retrospective cohort study
Objective	To estimate the effect of receiving at least one dose of COVID-19 mRNA vaccine within 100 days after initiation of immune checkpoint inhibitor (ICI) therapy on subsequent mortality among adult cancer patients.	Same objective, using the French national health data system (SNDS) and a cloning–censoring–weighting approach to emulate the target trial.
Eligibility criteria	Adults (≥18 years) diagnosed with cancer and initiating a first ICI (anti-PD1, anti-PDL1 or anti-CTLA4) after 28 December 2020 (i.e., after COVID-19 vaccines became available).	Same criteria as for the target trial, operationalized in the SNDS, with the additional requirement that patients initiate ICI before 22 March 2023 (i.e., within 100 days before the end of available COVID-19 infection data in the SNDS).
Exclusion criteria	Receipt of at least one dose of any COVID-19 vaccine (mRNA or non-mRNA) within the 100 days prior to ICI initiation; history of solid organ or bone marrow transplantation; HIV infection.	Same criteria defined using vaccination records in the SNDS, plus exclusion of individuals with <3 years of data available in the SNDS before ICI initiation.
Time zero (baseline)	Date of first ICI administration (treatment initiation).	Date of first ICI administration (treatment initiation).
Treatment strategies	1/ Receive at least 1 dose of COVID-19 mRNA vaccine in the 100 days after the 1 st ICI injection 2/ Do not receive any COVID-19 vaccine in the 100 days after the 1 st injection of ICI.	Same strategies, defined using vaccination records in the SNDS. Individuals who received only non-mRNA COVID-19 vaccines in this window follow neither strategy (and are censored in this analysis).
Treatment assignment	Individuals are randomly assigned to a treatment strategy at baseline and individuals and their treating physicians are aware of the assigned treatment strategy.	Treatment is not randomized. At baseline, eligible patients are cloned into both strategy arms. Within each arm, patients are censored at the time they deviate from the assigned strategy. Inverse probability of censoring weights (IPCW) are used to emulate randomization and adjust for confounding and informative censoring using baseline, measured at (or before) ICI initiation, or time-dependent covariates*.
Treatment implementation	100 days grace period.	100 days grace period.
Outcomes	Primary outcome: all-cause mortality. Secondary outcomes: 1) non-COVID-19-related mortality; 2) cancer-related mortality and 3) Progression Free Survival (PFS).	Primary outcome: all-cause mortality. Secondary outcomes: 1) non-COVID-19–related mortality (analyses restricted to deaths occurring before 2024 because cause-of-death data were not yet available for 2024); 2) cancer related mortality and 3) real-world Progression Free Survival (rwPFS).
Follow-up	Follow-up begins after randomization (ICI start) and continues until earliest occurrence of: 1)	Same as target trial except follow-up begins at ICI initiation.

	the event of interest, 2) deviation from the assigned strategy, 3) death (outcome of interest) or 4) December 31, 2024 (administrative censoring).	
Causal contrasts	Per-protocol effect	Observational analogue of the per-protocol effect
Estimand	Absolute survival differences and hazard ratios at 3, 6, 12 and 24 months between the 2 strategies, considering competing events where appropriate (cause-specific mortality outcomes)	Weighted absolute survival differences and weighted hazard ratios at 3, 6, 12 and 24 months between the 2 strategies, considering competing events where appropriate (cause-specific mortality outcomes)
Statistical analysis	Cox proportional hazards models to estimate hazard ratios for all-cause, cancer and non-COVID-19–related mortality and PFS under a per-protocol framework, censoring patients at the time of protocol deviation; secondary analyses stratified by cancer type (metastasis, lung, melanoma, head and neck, urovesical and kidney cancers).	In the cloned datasets, clones who deviate from their assigned strategy are censored at the time of deviation. Inverse probability weights are applied to adjust for informative censoring and confounding, and weighted Cox proportional hazards models are used to estimate hazard ratios for all-cause, cancer and non-COVID-19–related mortality and rwPFS. Secondary analyses mirror those specified for the target trial.

*List of covariates included in the models: age, sex, low-income status, deprivation index, region of residence, primary tumor site, a proxy for metastatic disease (presence of metastasis codes), the type of ICI regimen (anti–PD1, anti–PDL1, or anti–PD1+anti–CTLA4), calendar year of ICI initiation, cancer radiotherapy in the last 3 years, chemotherapy in the last 3 years, major cancer surgeries in the last 3 years, proxy of performance status, volume of inclusion in the center, anti-angiogenic therapy in the last 3 months, baseline and time updated cancer-related frailty variables such as malnutrition, at least 2 ambulance transports on separate days, at least 1 emergency department visit, at least 1 intensive care unit admission, at least 1 hospitalization in a rehabilitation or long-term care facility, at least 1 at-home hospitalization, at least 1 home nursing care visit, use of home oxygen therapy, and at least 1 palliative care stay in the last 6 months, baseline and time updated treatments such as opioids, antibiotics, antiepileptics, bisphosphonates, anti-RANKL (receptor activator of nuclear factor kappa-B ligand) agents, proton pump inhibitors, and corticosteroids (defined as at least 7 mg/day prednisone) in the last 3 months, number of general practitioner consultations in the previous 6 months, receipt of any non-COVID vaccination within 1 year before ICI initiation and other comorbidities such as respiratory failure, chronic obstructive pulmonary disease or emphysema, heart failure, hypertension, diabetes and obesity in the past 2 years.

#Dates of death (all-cause mortality) were available through December 31, 2024, whereas cause of death was available through December 31, 2023; accordingly, all-cause survival analyses were administratively censored on December 31, 2024, and cause-specific/competing-risk analyses on December 31, 2023

Supplementary Data

Supplementary Table-1. Characteristics of the population at index date by vaccination status within 100 days before ICI initiation in lung/respiratory cancers

Variables	COVID-19 mRNA vaccine (≥1 dose)*	Non-mRNA COVID-19 vaccine (≥1 dose)*	No vaccine	Total
Number of patients	13,638	1,316	30,871	45,825
Age (Med [IQR], years)	67 [61;73]	66 [61;70]	66 [60;73]	67 [60;73]
Sex (Men)	9215 (67.6%)	962 (73.1%)	20481 (66.3%)	30658 (66.9%)
Low income (Yes)	1173 (8.6%)	100 (7.6%)	3702 (12%)	4975 (10.9%)
<i>Deprivation index</i>				
1 (least deprivation)	2315 (17.0%)	206 (15.7%)	4706 (15.2%)	7227 (15.8%)
2	2604 (19.1%)	229 (17.4%)	5545 (18.0%)	8378 (18.3%)
3	2902 (21.3%)	297 (22.6%)	6771 (21.9%)	9970 (21.8%)
4	2922 (21.4%)	302 (22.9%)	6825 (22.1%)	10049 (21.9%)
5 (most deprivation)	2895 (21.2%)	282 (21.4%)	7024 (22.8%)	10201 (22.3%)
<i>Region of residence</i>				
Auvergne-Rhône Alpes	1613 (11.8%)	165 (12.5%)	3485 (11.3%)	5263 (11.5%)
Bourgogne Franche Comté	620 (4.5%)	45 (3.4%)	1387 (4.5%)	2052 (4.5%)
Bretagne	834 (6.1%)	98 (7.4%)	1751 (5.7%)	2683 (5.9%)
Centre-Val de Loire	558 (4.1%)	60 (4.6%)	1207 (3.9%)	1825 (4.0%)
Corse	101 (0.7%)	6 (0.5%)	250 (0.8%)	357 (0.8%)
Grand Est	1127 (8.3%)	97 (7.4%)	2665 (8.6%)	3889 (8.5%)
Outre Mer	88 (0.6%)	0 (0.0%)	354 (1.1%)	442 (1.0%)
Hauts de France	1181 (8.7%)	144 (10.9%)	2727 (8.8%)	4052 (8.8%)
Ile de France	1817 (13.3%)	136 (10.3%)	3950 (12.8%)	5903 (12.9%)
Normandie	840 (6.2%)	85 (6.5%)	1768 (5.7%)	2693 (5.9%)
Nouvelle Aquitaine	1564 (11.5%)	164 (12.5%)	3408 (11.0%)	5136 (11.2%)
Occitanie	1410 (10.3%)	155 (11.8%)	3597 (11.7%)	5162 (11.3%)
Pays de Loire	712 (5.2%)	93 (7.1%)	1499 (4.9%)	2304 (5.0%)
Provence Alpes Côte d'Azur	1173 (8.6%)	68 (5.2%)	2823 (9.1%)	4064 (8.9%)
<i>Year of ICI initiation</i>				
2020-2021	7191 (52.7%)	1311 (99.6%)	12014 (38.9%)	20516 (44.8%)
2022	5691 (41.7%)	4 (0.3%)	14913 (48.3%)	20608 (45.0%)
2023	756 (5.5%)	1 (0.1%)	3944 (12.8%)	4701 (10.3%)
<i>ICI regimen</i>				
Anti-PD1	9998 (73.3%)	976 (74.2%)	22434 (72.7%)	33408 (72.9%)
Anti-PDL1	3574 (26.2%)	334 (25.4%)	8314 (26.9%)	12222 (26.7%)
Anti-PD1/CTLA4	66 (0.5%)	6 (0.5%)	123 (0.4%)	195 (0.4%)
<i>Metastatic cancer</i>	8897 (65.2%)	869 (66%)	20787 (67.3%)	30553 (66.7%)
<i>Poor performance status proxy</i>	3028 (22.2%)	381 (29%)	8307 (26.9%)	11716 (25.6%)
<i>Volume of inclusion</i>				
high (top 10% centers)	882 (6.5%)	86 (6.5%)	2004 (6.5%)	2972 (6.5%)
intermediate (10–40%)	3704 (27.2%)	360 (27.4%)	8088 (26.2%)	12152 (26.5%)
low (bottom 60%)	9052 (66.4%)	870 (66.1%)	20779 (67.3%)	30701 (67.0%)
<i>Major cancer surgery ≤3 years</i>	1988 (14.6%)	153 (11.6%)	3834 (12.4%)	5975 (13%)
<i>Chemotherapy ≤3years</i>	7158 (52.5%)	594 (45.1%)	16340 (52.9%)	24092 (52.6%)
<i>Radiotherapy ≤3years</i>	5384 (39.5%)	427 (32.4%)	11578 (37.5%)	17389 (37.9%)
<i>Anti-angiogenic ≤3months</i>	107 (0.8%)	8 (0.6%)	284 (0.9%)	399 (0.9%)
<i>≥7mg EQ-PRED ≤3months</i>	8008 (58.7%)	770 (58.5%)	17868 (57.9%)	26646 (58.1%)
<i>Opioid ≤3 months</i>	6195 (45.4%)	658 (50%)	14497 (47%)	21350 (46.6%)

<i>Antibiotic ≤3 months</i>	5185 (38%)	523 (39.7%)	12217 (39.6%)	17925 (39.1%)
<i>Antiepileptic ≤3 months</i>	854 (6.3%)	81 (6.2%)	2081 (6.7%)	3016 (6.6%)
<i>Bisphosphonate ≤3 months</i>	123 (0.9%)	10 (0.8%)	281 (0.9%)	414 (0.9%)
<i>Anti-RANKL ≤3 months</i>	415 (3%)	28 (2.1%)	798 (2.6%)	1241 (2.7%)
<i>Proton pump inhibitors ≤3 months</i>	7269 (53.3%)	714 (54.3%)	16601 (53.8%)	24584 (53.6%)
<i>Malnutrition ≤6 months</i>	2373 (17.4%)	253 (19.2%)	7042 (22.8%)	9668 (21.1%)
<i>≥2 ambulance transports on separate days ≤6 months</i>	1745 (12.8%)	151 (11.5%)	4598 (14.9%)	6494 (14.2%)
<i>≥1 emergency department visit ≤6 months</i>	5241 (38.4%)	534 (40.6%)	12964 (42%)	18739 (40.9%)
<i>≥1 intensive care unit ≤6 months</i>	1917 (14.1%)	201 (15.3%)	4889 (15.8%)	7007 (15.3%)
<i>≥1 at-home hospitalization ≤6 months</i>	227 (1.7%)	14 (1.1%)	596 (1.9%)	837 (1.8%)
<i>≥1 rehabilitation or long-term care ≤6 months</i>	551 (4%)	33 (2.5%)	1503 (4.9%)	2087 (4.6%)
<i>≥1 home nursing care visit ≤6 months</i>	217 (1.6%)	10 (0.8%)	630 (2%)	857 (1.9%)
<i>Home oxygen ≤6 months</i>	1034 (7.6%)	103 (7.8%)	2575 (8.3%)	3712 (8.1%)
<i>≥1 palliative care stay ≤6 months</i>	521 (3.8%)	35 (2.7%)	1690 (5.5%)	2246 (4.9%)
<i>Heart Failure</i>	973 (7.1%)	99 (7.5%)	2472 (8%)	3544 (7.7%)
<i>COPD or emphysema</i>	3576 (26.2%)	374 (28.4%)	8437 (27.3%)	12387 (27%)
<i>Respiratory failure</i>	2105 (15.4%)	229 (17.4%)	5339 (17.3%)	7673 (16.7%)
<i>Diabetes</i>	2930 (21.5%)	339 (25.8%)	6640 (21.5%)	9909 (21.6%)
<i>Obesity</i>	983 (7.2%)	117 (8.9%)	2258 (7.3%)	3358 (7.3%)
<i>Hypertension</i>	7841 (57.5%)	802 (60.9%)	17323 (56.1%)	25966 (56.7%)
<i>COVID-19 infection <100days</i>	397 (2.9%)	13 (1.0%)	2566 (8.3%)	2976 (6.5%)
<i>Any non-COVID-19 vaccine ≤1y before pre-ICI period</i>	6891 (50.5%)	763 (58%)	13239 (42.9%)	20893 (45.6%)
<i>GP consultations≤6 months</i>				
0-3 consultations	4097 (30.0%)	221 (16.8%)	9445 (30.6%)	13763 (30.0%)
3-6 consultations	4780 (35.0%)	483 (36.7%)	10514 (34.1%)	15777 (34.4%)
>6 consultations	4761 (34.9%)	612 (46.5%)	10912 (35.3%)	16285 (35.5%)

Abbreviations: Anti-CTLA4: anti–cytotoxic T-lymphocyte–associated protein 4; anti-PD1: anti–programmed cell death protein 1; anti-PDL1: anti–programmed death-ligand 1; COPD: chronic obstructive pulmonary disease; EQ-PRED: equivalent prednisone; ICI: immune checkpoint inhibitor; IQR: interquartile range; Med: median; GP: General Practitioner; y: year

*Patients receiving both mRNA and non-mRNA COVID-19 vaccine (n=42) within 100 days before ICI start were included in the mRNA COVID-19 vaccine group

Supplementary Table-2. Characteristics of the population at index date by vaccination status within 100 days before ICI initiation in melanoma

Variables	COVID-19 mRNA vaccine (≥1 dose)*	Non-mRNA COVID-19 vaccine (≥1 dose)*	No vaccine	Total
Number of patients	2,078	151	4,918	7,147
<i>Age (Med [IQR], years)</i>	71 [59;78]	69 [63;73]	68 [55;77]	69 [57;77]
<i>Sex (Men)</i>	1225 (59%)	82 (54.3%)	2795 (56.8%)	4102 (57.4%)
<i>Low income (Yes)</i>	60 (2.9%)	4 (2.6%)	262 (5.3%)	326 (4.6%)
<i>Deprivation index</i>				
1 (least deprivation)	447 (21.5%)	32 (21.2%)	974 (19.8%)	1453 (20.3%)
2	390 (18.8%)	25 (16.6%)	965 (19.6%)	1380 (19.3%)
3	444 (21.4%)	29 (19.2%)	1087 (22.1%)	1560 (21.8%)
4	418 (20.1%)	37 (24.5%)	985 (20.0%)	1440 (20.1%)
5 (most deprivation)	379 (18.2%)	28 (18.5%)	907 (18.4%)	1314 (18.4%)
<i>Region of residence</i>				
Auvergne-Rhône Alpes	271 (13.0%)	26 (17.2%)	663 (13.5%)	960 (13.4%)
Bourgogne Franche Comté	104 (5.0%)	4 (2.6%)	203 (4.1%)	311 (4.4%)
Bretagne	134 (6.4%)	19 (12.6%)	315 (6.4%)	468 (6.5%)
Centre-Val de Loire	86 (4.1%)	5 (3.3%)	184 (3.7%)	275 (3.8%)
Corse	11 (0.5%)	0 (0.0%)	33 (0.7%)	44 (0.6%)
Grand Est	149 (7.2%)	5 (3.3%)	333 (6.8%)	487 (6.8%)
Outre Mer	15 (0.7%)	0 (0.0%)	59 (1.2%)	74 (1.0%)
Hauts de France	181 (8.7%)	15 (9.9%)	444 (9.0%)	640 (9.0%)
Ile de France	300 (14.4%)	19 (12.6%)	738 (15.0%)	1057 (14.8%)
Normandie	130 (6.3%)	14 (9.3%)	320 (6.5%)	464 (6.5%)
Nouvelle Aquitaine	229 (11.0%)	7 (4.6%)	456 (9.3%)	692 (9.7%)
Occitanie	188 (9.0%)	14 (9.3%)	436 (8.9%)	638 (8.9%)
Pays de Loire	147 (7.1%)	12 (7.9%)	300 (6.1%)	459 (6.4%)
Provence Alpes Côte d'Azur	133 (6.4%)	11 (7.3%)	434 (8.8%)	578 (8.1%)
<i>Year of ICI initiation</i>				
2020-2021	1083 (52.1%)	150 (99.3%)	1868 (38.0%)	3101 (43.4%)
2022	870 (41.9%)	1 (0.7%)	2344 (47.7%)	3215 (45.0%)
2023	125 (6.0%)	0 (0%)	706 (14.4%)	831 (11.6%)
<i>ICI regimen</i>				
Anti-PD1	1573 (75.7%)	114 (75.5%)	3637 (74.0%)	5324 (74.5%)
Anti-PDL1	7 (0.3%)	1 (0.7%)	12 (0.2%)	20 (0.3%)
Anti-PD1/CTLA4	498 (24.0%)	36 (23.8%)	1269 (25.8%)	1803 (25.2%)
<i>Metastatic cancer</i>	1561 (75.1%)	120 (79.5%)	3653 (74.3%)	5334 (74.6%)
<i>Poor performance status proxy</i>	165 (7.9%)	13 (8.6%)	438 (8.9%)	616 (8.6%)
<i>Volume of inclusion</i>				
high (top 10% centers)	431 (20.7%)	26 (17.2%)	1021 (20.8%)	1478 (20.7%)
intermediate (10–40%)	1058 (50.9%)	86 (57.0%)	2498 (50.8%)	3642 (51.0%)
low (bottom 60%)	589 (28.3%)	39 (25.8%)	1399 (28.4%)	2027 (28.4%)
<i>Major cancer surgery ≤3 years</i>	1293 (62.2%)	95 (62.9%)	2991 (60.8%)	4379 (61.3%)
<i>Chemotherapy ≤3years</i>	272 (13.1%)	23 (15.2%)	670 (13.6%)	965 (13.5%)
<i>Radiotherapy ≤3years</i>	260 (12.5%)	28 (18.5%)	612 (12.4%)	900 (12.6%)
<i>Anti-angiogenic ≤3months</i>	2 (0.1%)	0 (0.0%)	3 (0.1%)	5 (0.1%)
<i>≥7mg EQ-PRED <1month</i>	274 (13.2%)	22 (14.6%)	718 (14.6%)	1014 (14.2%)
<i>Opioid ≤3 months</i>	743 (35.8%)	63 (41.7%)	1858 (37.8%)	2664 (37.3%)
<i>Antibiotic ≤3 months</i>	562 (27%)	32 (21.2%)	1393 (28.3%)	1987 (27.8%)
<i>Antiepileptic ≤3 months</i>	95 (4.6%)	14 (9.3%)	220 (4.5%)	329 (4.6%)

<i>Bisphosphonate ≤3 months</i>	25 (1.2%)	0 (0%)	38 (0.8%)	63 (0.9%)
<i>Anti-RANKL ≤3 months</i>	25 (1.2%)	1 (0.7%)	39 (0.8%)	65 (0.9%)
<i>Proton pump inhibitors ≤3 months</i>	684 (32.9%)	44 (29.1%)	1561 (31.7%)	2289 (32%)
<i>Malnutrition ≤6 months</i>	113 (5.4%)	6 (4%)	263 (5.3%)	382 (5.3%)
<i>≥2 ambulance transports on separate days ≤6 months</i>	146 (7%)	6 (4%)	332 (6.8%)	484 (6.8%)
<i>≥1 emergency department visit ≤6 months</i>	432 (20.8%)	37 (24.5%)	1021 (20.8%)	1490 (20.8%)
<i>≥1 intensive care unit ≤6 months</i>	155 (7.5%)	11 (7.3%)	338 (6.9%)	504 (7.1%)
<i>≥1 at-home hospitalization ≤6 months</i>	28 (1.3%)	0 (0%)	86 (1.7%)	114 (1.6%)
<i>≥1 rehabilitation or long-term care ≤6 months</i>	49 (2.4%)	1 (0.7%)	110 (2.2%)	160 (2.2%)
<i>≥1 home nursing care visit ≤6 months</i>	36 (1.7%)	2 (1.3%)	84 (1.7%)	122 (1.7%)
<i>Home oxygen ≤6 months</i>	9 (0.4%)	1 (0.7%)	38 (0.8%)	48 (0.7%)
<i>≥1 palliative care stay ≤6 months</i>	50 (2.4%)	4 (2.6%)	123 (2.5%)	177 (2.5%)
<i>Heart Failure</i>	106 (5.1%)	8 (5.3%)	250 (5.1%)	364 (5.1%)
<i>COPD or emphysema</i>	90 (4.3%)	6 (4.0%)	190 (3.9%)	286 (4%)
<i>Respiratory failure</i>	82 (3.9%)	2 (1.3%)	175 (3.6%)	259 (3.6%)
<i>Diabetes</i>	440 (21.2%)	44 (29.1%)	985 (20%)	1469 (20.6%)
<i>Obesity</i>	169 (8.1%)	12 (7.9%)	449 (9.1%)	630 (8.8%)
<i>Hypertension</i>	1120 (53.9%)	90 (59.6%)	2494 (50.7%)	3704 (51.8%)
<i>COVID-19 infection <100days</i>	57 (2.7%)	0 (0.0%)	316 (6.4%)	373 (5.2%)
<i>Any non-COVID-19 vaccine ≤1y before pre-ICI period</i>	1037 (49.9%)	85 (56.3%)	1915 (38.9%)	3037 (42.5%)
<i>GP consultations ≤6months</i>				
0-3 consultations	932 (44.9%)	60 (39.7%)	2209 (44.9%)	3201 (44.8%)
3-6 consultations	647 (31.1%)	53 (35.1%)	1517 (30.8%)	2217 (31.0%)
>6 consultations	499 (24.0%)	38 (25.2%)	1192 (24.2%)	1729 (24.2%)

Abbreviations: Anti-CTLA4: anti-cytotoxic T-lymphocyte-associated protein 4; anti-PD1: anti-programmed cell death protein 1; anti-PDL1: anti-programmed death-ligand 1; COPD: chronic obstructive pulmonary disease; EQ-PRED: equivalent prednisone; ICI: immune checkpoint inhibitor; IQR: interquartile range; Med: median; GP: General Practitioner; y: year

*Patients receiving both mRNA and non-mRNA COVID-19 vaccine (n=5) within 100 days before ICI start were included in the mRNA COVID-19 vaccine group

Supplementary Table-3. Characteristics of the population at index date by vaccination status within 100 days before ICI initiation in head and neck cancers

Variables	COVID-19 mRNA vaccine (≥1 dose)*	Non-mRNA COVID-19 vaccine (≥1 dose)*	No vaccine	Total
Number of patients	2,027	209	4,98	7,216
Age (Med [IQR], years)	66 [60;73]	65 [60;70]	65 [58;72]	65 [59;72]
Sex (Men)	1592 (78.5%)	176 (84.2%)	3867 (77.7%)	5635 (78.1%)
Low income (Yes)	262 (12.9%)	32 (15.3%)	874 (17.6%)	1168 (16.2%)
Deprivation index				
1 (least deprivation)	285 (14.1%)	21 (10.0%)	627 (12.6%)	933 (12.9%)
2	369 (18.2%)	34 (16.3%)	802 (16.1%)	1205 (16.7%)
3	432 (21.3%)	36 (17.2%)	1155 (23.2%)	1623 (22.5%)
4	443 (21.9%)	47 (22.5%)	1128 (22.7%)	1618 (22.4%)
5 (most deprivation)	498 (24.6%)	71 (34.0%)	1268 (25.5%)	1837 (25.5%)
Region of residence				
Auvergne-Rhône Alpes	227 (11.2%)	13 (6.2%)	574 (11.5%)	814 (11.3%)
Bourgogne Franche Comté	112 (5.5%)	10 (4.8%)	258 (5.2%)	380 (5.3%)
Bretagne	146 (7.2%)	15 (7.2%)	304 (6.1%)	465 (6.4%)
Centre-Val de Loire	87 (4.3%)	11 (5.3%)	215 (4.3%)	313 (4.3%)
Corse	15 (0.7%)	0 (0.0%)	35 (0.7%)	50 (0.7%)
Grand Est	151 (7.4%)	11 (5.3%)	358 (7.2%)	520 (7.2%)
Outre Mer	16 (0.8%)	1 (0.5%)	120 (2.4%)	137 (1.9%)
Hauts de France	271 (13.4%)	46 (22.0%)	592 (11.9%)	909 (12.6%)
Ile de France	234 (11.5%)	23 (11.0%)	586 (11.8%)	843 (11.7%)
Normandie	110 (5.4%)	9 (4.3%)	292 (5.9%)	411 (5.7%)
Nouvelle Aquitaine	215 (10.6%)	21 (10.0%)	504 (10.1%)	740 (10.3%)
Occitanie	183 (9.0%)	21 (10.0%)	508 (10.2%)	712 (9.9%)
Pays de Loire	116 (5.7%)	18 (8.6%)	247 (5.0%)	381 (5.3%)
Provence Alpes Côte d'Azur	144 (7.1%)	10 (4.8%)	387 (7.8%)	541 (7.5%)
Year of ICI initiation				
2020-2021	1063 (52.4%)	209 (100%)	2047 (41.1%)	3319 (46.0%)
2022	854 (42.1%)	0 (0%)	2286 (45.9%)	3140 (43.5%)
2023	110 (5.4%)	0 (0%)	647 (13.0%)	757 (10.5%)
ICI regimen				
Anti-PD1	1986 (98.0%)	204 (97.6%)	4884 (98.1%)	7074 (98.0%)
Anti-PDL1	35 (1.7%)	5 (2.4%)	71 (1.4%)	111 (1.5%)
Anti-PD1/CTLA4	6 (0.3%)	0 (0%)	25 (0.5%)	31 (0.4%)
Metastatic cancer	1349 (66.6%)	141 (67.5%)	3245 (65.2%)	4735 (65.6%)
Poor performance status proxy	439 (21.7%)	48 (23%)	1159 (23.3%)	1646 (22.8%)
Volume of inclusion				
high (top 10% centers)	168 (8.3%)	17 (8.1%)	391 (7.9%)	576 (8.0%)
intermediate (10–40%)	674 (33.3%)	55 (26.3%)	1545 (31.0%)	2274 (31.5%)
low (bottom 60%)	1185 (58.5%)	137 (65.6%)	3044 (61.1%)	4366 (60.5%)
Major cancer surgery ≤3 years	687 (33.9%)	57 (27.3%)	1517 (30.5%)	2261 (31.3%)
Chemotherapy ≤3years	1458 (71.9%)	137 (65.6%)	3666 (73.6%)	5261 (72.9%)
Radiotherapy ≤3years	1304 (64.3%)	137 (65.6%)	3266 (65.6%)	4707 (65.2%)
Anti-angiogenic ≤3months	10 (0.5%)	1 (0.5%)	18 (0.4%)	29 (0.4%)
≥7mg EQ-PRED <1month	727 (35.9%)	71 (34%)	1853 (37.2%)	2651 (36.7%)
Opioid ≤3 months	1171 (57.8%)	133 (63.6%)	2990 (60%)	4294 (59.5%)
Antibiotic ≤3 months	1008 (49.7%)	95 (45.5%)	2458 (49.4%)	3561 (49.3%)
Antiepileptic ≤3 months	79 (3.9%)	9 (4.3%)	193 (3.9%)	281 (3.9%)
Bisphosphonate ≤3 months	23 (1.1%)	1 (0.5%)	45 (0.9%)	69 (1%)

<i>Anti-RANKL ≤3 months</i>	19 (0.9%)	1 (0.5%)	42 (0.8%)	62 (0.9%)
<i>Proton pump inhibitors ≤3 months</i>	956 (47.2%)	102 (48.8%)	2230 (44.8%)	3288 (45.6%)
<i>Malnutrition ≤6 months</i>	583 (28.8%)	50 (23.9%)	1648 (33.1%)	2281 (31.6%)
<i>≥2 ambulance transports on separate days ≤6 months</i>	302 (14.9%)	21 (10%)	892 (17.9%)	1215 (16.8%)
<i>≥1 emergency department visit ≤6 months</i>	583 (28.8%)	61 (29.2%)	1521 (30.5%)	2165 (30%)
<i>≥1 intensive care unit ≤6 months</i>	235 (11.6%)	18 (8.6%)	643 (12.9%)	896 (12.4%)
<i>≥1 at-home hospitalization ≤6 months</i>	73 (3.6%)	6 (2.9%)	227 (4.6%)	306 (4.2%)
<i>≥1 rehabilitation or long-term care ≤6 months</i>	93 (4.6%)	7 (3.3%)	288 (5.8%)	388 (5.4%)
<i>≥1 home nursing care visit ≤6 months</i>	52 (2.6%)	2 (1%)	164 (3.3%)	218 (3%)
<i>Home oxygen ≤6 months</i>	57 (2.8%)	4 (1.9%)	133 (2.7%)	194 (2.7%)
<i>≥1 palliative care stay ≤6 months</i>	89 (4.4%)	8 (3.8%)	321 (6.4%)	418 (5.8%)
<i>Heart Failure</i>	167 (8.2%)	12 (5.7%)	390 (7.8%)	569 (7.9%)
<i>COPD or emphysema</i>	447 (22.1%)	45 (21.5%)	1055 (21.2%)	1547 (21.4%)
<i>Respiratory failure</i>	366 (18.1%)	33 (15.8%)	906 (18.2%)	1305 (18.1%)
<i>Diabetes</i>	394 (19.4%)	44 (21.1%)	831 (16.7%)	1269 (17.6%)
<i>Obesity</i>	151 (7.4%)	12 (5.7%)	304 (6.1%)	467 (6.5%)
<i>Hypertension</i>	1236 (61%)	127 (60.8%)	2880 (57.8%)	4243 (58.8%)
<i>COVID-19 infection <100days</i>	53 (2.6%)	1 (0.5%)	343 (6.9%)	397 (5.5%)
<i>Any non-COVID-19 vaccine ≤1y before pre-ICI period</i>	1005 (49.6%)	120 (57.4%)	1998 (40.1%)	3123 (43.3%)
<i>GP consultations ≤6months</i>				
0-3 consultations	760 (37.5%)	47 (22.5%)	1757 (35.3%)	2564 (35.5%)
3-6 consultations	584 (28.8%)	71 (34.0%)	1395 (28.0%)	2050 (28.4%)
>6 consultations	683 (33.7%)	91 (43.5%)	1828 (36.7%)	2602 (36.1%)

Abbreviations: Anti-CTLA4: anti-cytotoxic T-lymphocyte-associated protein 4; anti-PD1: anti-programmed cell death protein 1; anti-PDL1: anti-programmed death-ligand 1; COPD: chronic obstructive pulmonary disease; EQ-PRED: equivalent prednisone; ICI: immune checkpoint inhibitor; IQR: interquartile range; Med: median; GP: General Practitioner; y: year

*Patients receiving both mRNA and non-mRNA COVID-19 vaccine (n=1) within 100 days before ICI start were included in the mRNA COVID-19 vaccine group

Supplementary-4. Characteristics of the population at index date by vaccination status within 100 days before ICI initiation in urovesical cancers

Variables	COVID-19 mRNA vaccine (≥1 dose)*	Non-mRNA COVID-19 vaccine (≥1 dose)*	No vaccine	Total
Number of patients	2,013	91	4,129	6,233
<i>Age (Med [IQR], years)</i>	73 [66;78]	69 [63;74]	72 [65;77]	72 [65;78]
<i>Sex (Men)</i>	1619 (80.4%)	78 (85.7%)	3244 (78.6%)	4941 (79.3%)
<i>Low income (Yes)</i>	77 (3.8%)	3 (3.3%)	283 (6.9%)	363 (5.8%)
<i>Deprivation index</i>				
1 (least deprivation)	447 (22.2%)	14 (15.4%)	832 (20.2%)	1293 (20.7%)
2	395 (19.6%)	20 (22.0%)	787 (19.1%)	1202 (19.3%)
3	407 (20.2%)	23 (25.3%)	905 (21.9%)	1335 (21.4%)
4	428 (21.3%)	16 (17.6%)	783 (19.0%)	1227 (19.7%)
5 (most deprivation)	336 (16.7%)	18 (19.8%)	822 (19.9%)	1176 (18.9%)
<i>Region of residence</i>				
Auvergne-Rhône Alpes	240 (11.9%)	10 (11.0%)	453 (11.0%)	703 (11.3%)
Bourgogne Franche Comté	113 (5.6%)	3 (3.3%)	186 (4.5%)	302 (4.8%)
Bretagne	96 (4.8%)	11 (12.1%)	179 (4.3%)	286 (4.6%)
Centre-Val de Loire	81 (4.0%)	5 (5.5%)	155 (3.8%)	241 (3.9%)
Corse	10 (0.5%)	0 (0.0%)	30 (0.7%)	40 (0.6%)
Grand Est	154 (7.7%)	4 (4.4%)	308 (7.5%)	466 (7.5%)
Outre Mer	16 (0.8%)	1 (1.1%)	31 (0.8%)	48 (0.8%)
Hauts de France	150 (7.5%)	8 (8.8%)	351 (8.5%)	509 (8.2%)
Ile de France	348 (17.3%)	13 (14.3%)	652 (15.8%)	1013 (16.3%)
Normandie	87 (4.3%)	1 (1.1%)	194 (4.7%)	282 (4.5%)
Nouvelle Aquitaine	242 (12.0%)	12 (13.2%)	462 (11.2%)	716 (11.5%)
Occitanie	193 (9.6%)	13 (14.3%)	442 (10.7%)	648 (10.4%)
Pays de Loire	84 (4.2%)	5 (5.5%)	219 (5.3%)	308 (4.9%)
Provence Alpes Côte d'Azur	199 (9.9%)	5 (5.5%)	467 (11.3%)	671 (10.8%)
<i>Year of ICI initiation</i>				
2020-2021	1088 (54.0%)	90 (98.9%)	1500 (36.3%)	2678 (43.0%)
2022	792 (39.3%)	0 (0%)	2040 (49.4%)	2832 (45.4%)
2023	133 (6.6%)	1 (1.1%)	589 (14.3%)	723 (11.6%)
<i>ICI regimen</i>				
Anti-PD1	1063 (52.8%)	50 (54.9%)	2392 (57.9%)	3505 (56.2%)
Anti-PDL1	941 (46.7%)	41 (45.1%)	1730 (41.9%)	2712 (43.5%)
Anti-PD1/CTLA4	9 (0.4%)	0 (0%)	7 (0.2%)	16 (0.3%)
<i>Metastatic cancer</i>	1433 (71.2%)	60 (65.9%)	2889 (70%)	4382 (70.3%)
<i>Poor performance status proxy</i>	182 (9%)	8 (8.8%)	500 (12.1%)	690 (11.1%)
<i>Volume of inclusion</i>				
high (top 10% centers)	142 (7.1%)	6 (6.6%)	287 (7.0%)	435 (7.0%)
intermediate (10–40%)	514 (25.5%)	23 (25.3%)	1018 (24.7%)	1555 (24.9%)
low (bottom 60%)	1357 (67.4%)	62 (68.1%)	2824 (68.4%)	4243 (68.1%)
<i>Major cancer surgery ≤3 years</i>	896 (44.5%)	33 (36.3%)	1783 (43.2%)	2712 (43.5%)
<i>Chemotherapy ≤3years</i>	1856 (92.2%)	82 (90.1%)	3836 (92.9%)	5774 (92.6%)
<i>Radiotherapy ≤3years</i>	523 (26%)	29 (31.9%)	1068 (25.9%)	1620 (26%)
<i>Anti-angiogenic ≤3months</i>	19 (0.9%)	1 (1.1%)	29 (0.7%)	49 (0.8%)
<i>≥7mg EQ-PRED <1month</i>	716 (35.6%)	27 (29.7%)	1437 (34.8%)	2180 (35%)
<i>Opioid ≤3 months</i>	774 (38.5%)	31 (34.1%)	1671 (40.5%)	2476 (39.7%)
<i>Antibiotic ≤3 months</i>	789 (39.2%)	34 (37.4%)	1740 (42.1%)	2563 (41.1%)
<i>Antiepileptic ≤3 months</i>	48 (2.4%)	0 (0%)	88 (2.1%)	136 (2.2%)
<i>Bisphosphonate ≤3 months</i>	7 (0.3%)	2 (2.2%)	19 (0.5%)	28 (0.4%)

<i>Anti-RANKL ≤3 months</i>	67 (3.3%)	5 (5.5%)	127 (3.1%)	199 (3.2%)
<i>Proton pump inhibitors ≤3 months</i>	872 (43.3%)	36 (39.6%)	1832 (44.4%)	2740 (44%)
<i>Malnutrition ≤6 months</i>	378 (18.8%)	10 (11%)	955 (23.1%)	1343 (21.5%)
<i>≥2 ambulance transports on separate days ≤6 months</i>	346 (17.2%)	10 (11%)	828 (20.1%)	1184 (19%)
<i>≥1 emergency department visit ≤6 months</i>	789 (39.2%)	26 (28.6%)	1674 (40.5%)	2489 (39.9%)
<i>≥1 intensive care unit ≤6 months</i>	316 (15.7%)	10 (11%)	758 (18.4%)	1084 (17.4%)
<i>≥1 at-home hospitalization ≤6 months</i>	62 (3.1%)	2 (2.2%)	160 (3.9%)	224 (3.6%)
<i>≥1 rehabilitation or long-term care ≤6 months</i>	120 (6%)	2 (2.2%)	266 (6.4%)	388 (6.2%)
<i>≥1 home nursing care visit ≤6 months</i>	74 (3.7%)	4 (4.4%)	196 (4.7%)	274 (4.4%)
<i>Home oxygen ≤6 months</i>	45 (2.2%)	2 (2.2%)	74 (1.8%)	121 (1.9%)
<i>≥1 palliative care stay ≤6 months</i>	104 (5.2%)	5 (5.5%)	271 (6.6%)	380 (6.1%)
<i>Heart Failure</i>	187 (9.3%)	6 (6.6%)	369 (8.9%)	562 (9%)
<i>COPD or emphysema</i>	280 (13.9%)	11 (12.1%)	618 (15%)	909 (14.6%)
<i>Respiratory failure</i>	178 (8.8%)	2 (2.2%)	416 (10.1%)	596 (9.6%)
<i>Diabetes</i>	471 (23.4%)	19 (20.9%)	1016 (24.6%)	1506 (24.2%)
<i>Obesity</i>	254 (12.6%)	8 (8.8%)	483 (11.7%)	745 (12%)
<i>Hypertension</i>	1381 (68.6%)	62 (68.1%)	2748 (66.6%)	4191 (67.2%)
<i>COVID-19 infection <100days</i>	69 (3.4%)	0 (0%)	365 (8.8%)	434 (7%)
<i>Any non-COVID-19 vaccine ≤1y before pre-ICI period</i>	1209 (60.1%)	50 (54.9%)	2126 (51.5%)	3385 (54.3%)
<i>GP consultations ≤6months</i>				
0-3 consultations	664 (33.0%)	26 (28.6%)	1384 (33.5%)	2074 (33.3%)
3-6 consultations	601 (29.9%)	24 (26.4%)	1197 (29.0%)	1822 (29.2%)
>6 consultations	748 (37.2%)	41 (45.1%)	1548 (37.5%)	2337 (37.5%)

Abbreviations: Anti-CTLA4: anti-cytotoxic T-lymphocyte-associated protein 4; anti-PD1: anti-programmed cell death protein 1; anti-PDL1: anti-programmed death-ligand 1; COPD: chronic obstructive pulmonary disease; EQ-PRED: equivalent prednisone; ICI: immune checkpoint inhibitor; IQR: interquartile range; Med: median; GP: General Practitioner; y: year

*Patients receiving both mRNA and non-mRNA COVID-19 vaccine (n=3) within 100 days before ICI start were included in the mRNA COVID-19 vaccine group

Supplementary Table-5. Characteristics of the population at index date by vaccination status within 100 days before ICI initiation in kidney cancers

Variables	COVID-19 mRNA vaccine (≥1 dose)*	Non-mRNA COVID-19 vaccine (≥1 dose)*	No vaccine	Total
Number of patients	2,014	186	4,057	6,257
<i>Age (Med [IQR], years)</i>	69 [62;76]	67 [62;71]	68 [60;75]	69 [61;75]
<i>Sex (Men)</i>	1507 (74.8%)	140 (75.3%)	2940 (72.5%)	4587 (73.3%)
<i>Low income (Yes)</i>	109 (5.4%)	9 (4.8%)	268 (6.6%)	386 (6.2%)
<i>Deprivation index</i>				
1 (least deprivation)	357 (17.7%)	28 (15.1%)	633 (15.6%)	1018 (16.3%)
2	359 (17.8%)	35 (18.8%)	743 (18.3%)	1137 (18.2%)
3	440 (21.8%)	46 (24.7%)	935 (23.0%)	1421 (22.7%)
4	447 (22.2%)	48 (25.8%)	887 (21.9%)	1382 (22.1%)
5 (most deprivation)	411 (20.4%)	29 (15.6%)	859 (21.2%)	1299 (20.8%)
<i>Region of residence</i>				
Auvergne-Rhône Alpes	250 (12.4%)	18 (9.7%)	463 (11.4%)	731 (11.7%)
Bourgogne Franche Comté	122 (6.1%)	10 (5.4%)	227 (5.6%)	359 (5.7%)
Bretagne	126 (6.3%)	15 (8.1%)	196 (4.8%)	337 (5.4%)
Centre-Val de Loire	101 (5.0%)	7 (3.8%)	174 (4.3%)	282 (4.5%)
Corse	10 (0.5%)	0 (0.0%)	19 (0.5%)	29 (0.5%)
Grand Est	171 (8.5%)	15 (8.1%)	386 (9.5%)	572 (9.1%)
Outre Mer	18 (0.9%)	3 (1.6%)	63 (1.6%)	84 (1.3%)
Hauts de France	167 (8.3%)	20 (10.8%)	332 (8.2%)	519 (8.3%)
Ile de France	235 (11.7%)	26 (14.0%)	468 (11.5%)	729 (11.7%)
Normandie	112 (5.6%)	7 (3.8%)	271 (6.7%)	390 (6.2%)
Nouvelle Aquitaine	232 (11.5%)	31 (16.7%)	476 (11.7%)	739 (11.8%)
Occitanie	177 (8.8%)	16 (8.6%)	432 (10.6%)	625 (10.0%)
Pays de Loire	148 (7.3%)	15 (8.1%)	258 (6.4%)	421 (6.7%)
Provence Alpes Côte d'Azur	145 (7.2%)	3 (1.6%)	292 (7.2%)	440 (7.0%)
<i>Year of ICI initiation</i>				
2020-2021	1092 (54.2%)	185 (99.5%)	1665 (41.0%)	2942 (47.0%)
2022	822 (40.8%)	1 (0.5%)	1876 (46.2%)	2699 (43.1%)
2023	100 (5.0%)	0 (0%)	516 (12.7%)	616 (9.8%)
<i>ICI regimen</i>				
Anti-PD1	1410 (70.0%)	126 (67.7%)	2931 (72.2%)	4467 (71.4%)
Anti-PDL1	49 (2.4%)	1 (0.5%)	76 (1.9%)	126 (2.0%)
Anti-PD1/CTLA4	555 (27.6%)	59 (31.7%)	1050 (25.9%)	1664 (26.6%)
<i>Metastatic cancer</i>	1571 (78%)	138 (74.2%)	3206 (79%)	4915 (78.6%)
<i>Poor performance status proxy</i>	177 (8.8%)	14 (7.5%)	517 (12.7%)	708 (11.3%)
<i>Volume of inclusion</i>				
high (top 10% centers)	156 (7.7%)	15 (8.1%)	324 (8.0%)	495 (7.9%)
intermediate (10–40%)	652 (32.4%)	46 (24.7%)	1211 (29.8%)	1909 (30.5%)
low (bottom 60%)	1206 (59.9%)	125 (67.2%)	2522 (62.2%)	3853 (61.6%)
<i>Major cancer surgery ≤3 years</i>	768 (38.1%)	63 (33.9%)	1457 (35.9%)	2288 (36.6%)
<i>Chemotherapy ≤3years</i>	301 (14.9%)	18 (9.7%)	674 (16.6%)	993 (15.9%)
<i>Radiotherapy ≤3years</i>	497 (24.7%)	35 (18.8%)	977 (24.1%)	1509 (24.1%)
<i>Anti-angiogenic ≤3months</i>	979 (48.6%)	106 (57%)	2014 (49.6%)	3099 (49.5%)
<i>≥7mg EQ-PRED <1month</i>	403 (20%)	29 (15.6%)	918 (22.6%)	1350 (21.6%)
<i>Opioid ≤3 months</i>	709 (35.2%)	73 (39.2%)	1630 (40.2%)	2412 (38.5%)
<i>Antibiotic ≤3 months</i>	509 (25.3%)	29 (15.6%)	1065 (26.3%)	1603 (25.6%)
<i>Antiepileptic ≤3 months</i>	61 (3%)	6 (3.2%)	145 (3.6%)	212 (3.4%)
<i>Bisphosphonate ≤3 months</i>	18 (0.9%)	1 (0.5%)	32 (0.8%)	51 (0.8%)

<i>Anti-RANKL ≤3 months</i>	40 (2%)	1 (0.5%)	59 (1.5%)	100 (1.6%)
<i>Proton pump inhibitors ≤3 months</i>	925 (45.9%)	85 (45.7%)	1814 (44.7%)	2824 (45.1%)
<i>Malnutrition ≤6 months</i>	243 (12.1%)	15 (8.1%)	628 (15.5%)	886 (14.2%)
<i>≥2 ambulance transports on separate days ≤6 months</i>	206 (10.2%)	12 (6.5%)	525 (12.9%)	743 (11.9%)
<i>≥1 emergency department visit ≤6 months</i>	650 (32.3%)	54 (29%)	1466 (36.1%)	2170 (34.7%)
<i>≥1 intensive care unit ≤6 months</i>	293 (14.5%)	20 (10.8%)	650 (16%)	963 (15.4%)
<i>≥1 at-home hospitalization ≤6 months</i>	28 (1.4%)	0 (0.0%)	46 (1.1%)	74 (1.2%)
<i>≥1 rehabilitation or long-term care ≤6 months</i>	80 (4%)	4 (2.2%)	240 (5.9%)	324 (5.2%)
<i>≥1 home nursing care visit ≤6 months</i>	25 (1.2%)	2 (1.1%)	80 (2%)	107 (1.7%)
<i>Home oxygen ≤6 months</i>	35 (1.7%)	3 (1.6%)	76 (1.9%)	114 (1.8%)
<i>≥1 palliative care stay ≤6 months</i>	56 (2.8%)	8 (4.3%)	197 (4.9%)	261 (4.2%)
<i>Heart Failure</i>	170 (8.4%)	5 (2.7%)	275 (6.8%)	450 (7.2%)
<i>COPD or emphysema</i>	136 (6.8%)	14 (7.5%)	269 (6.6%)	419 (6.7%)
<i>Respiratory failure</i>	166 (8.2%)	13 (7.0%)	314 (7.7%)	493 (7.9%)
<i>Diabetes</i>	643 (31.9%)	66 (35.5%)	1158 (28.5%)	1867 (29.8%)
<i>Obesity</i>	258 (12.8%)	33 (17.7%)	509 (12.5%)	800 (12.8%)
<i>Hypertension</i>	1415 (70.3%)	132 (71.0%)	2730 (67.3%)	4277 (68.4%)
<i>COVID-19 infection <100days</i>	58 (2.9%)	2 (1.1%)	323 (8.0%)	383 (6.1%)
<i>Any non-COVID-19 vaccine ≤1year before pre-ICI period</i>	1108 (55.0%)	112 (60.2%)	1867 (46.0%)	3087 (49.3%)
<i>GP consultations ≤6months</i>				
0-3 consultations	701 (34.8%)	42 (22.6%)	1406 (34.7%)	2149 (34.3%)
3-6 consultations	687 (34.1%)	74 (39.8%)	1361 (33.5%)	2122 (33.9%)
>6 consultations	626 (31.1%)	70 (37.6%)	1290 (31.8%)	1986 (31.7%)

Abbreviations: Anti-CTLA4: anti-cytotoxic T-lymphocyte-associated protein 4; anti-PD1: anti-programmed cell death protein 1; anti-PDL1: anti-programmed death-ligand 1; COPD: chronic obstructive pulmonary disease; EQ-PRED: equivalent prednisone; ICI: immune checkpoint inhibitor; IQR: interquartile range; Med: median; GP: General Practitioner; y: year

*Patients receiving both mRNA and non-mRNA COVID-19 vaccine (n=2) within 100 days before ICI start were included in the mRNA COVID-19 vaccine group

Supplementary Table-6 Characteristics of the population at index date by vaccination status within 100 days before ICI initiation in liver cancers.

Variables	COVID-19 mRNA vaccine (≥1 dose)*	Non-mRNA COVID-19 vaccine (≥1 dose)*	No vaccine	Total
Number of patients	1,609	190	3,696	5,495
<i>Age (Med [IQR], years)</i>	71 [65;76]	68 [63;72]	70 [64;76]	71 [64;76]
<i>Sex (Men)</i>	1403 (87.2%)	165 (86.8%)	3178 (86%)	4746 (86.4%)
<i>Low income (Yes)</i>	128 (8.0%)	13 (6.8%)	319 (8.6%)	460 (8.4%)
<i>Deprivation index</i>				
1 (least deprivation)	249 (15.5%)	20 (10.5%)	558 (15.1%)	827 (15.1%)
2	293 (18.2%)	38 (20.0%)	702 (19.0%)	1033 (18.8%)
3	328 (20.4%)	43 (22.6%)	792 (21.4%)	1163 (21.2%)
4	372 (23.1%)	41 (21.6%)	802 (21.7%)	1215 (22.1%)
5 (most deprivation)	367 (22.8%)	48 (25.3%)	842 (22.8%)	1257 (22.9%)
<i>Region of residence</i>				
Auvergne-Rhône Alpes	200 (12.4%)	14 (7.4%)	495 (13.4%)	709 (12.9%)
Bourgogne Franche Comté	81 (5.0%)	5 (2.6%)	145 (3.9%)	231 (4.2%)
Bretagne	107 (6.7%)	21 (11.1%)	224 (6.1%)	352 (6.4%)
Centre-Val de Loire	72 (4.5%)	11 (5.8%)	158 (4.3%)	241 (4.4%)
Corse	9 (0.6%)	0 (0.0%)	26 (0.7%)	35 (0.6%)
Grand Est	114 (7.1%)	12 (6.3%)	258 (7.0%)	384 (7.0%)
Outre Mer	11 (0.7%)	0 (0.0%)	32 (0.9%)	43 (0.8%)
Hauts de France	208 (12.9%)	32 (16.8%)	449 (12.1%)	689 (12.5%)
Ile de France	211 (13.1%)	20 (10.5%)	528 (14.3%)	759 (13.8%)
Normandie	88 (5.5%)	13 (6.8%)	191 (5.2%)	292 (5.3%)
Nouvelle Aquitaine	120 (7.5%)	10 (5.3%)	299 (8.1%)	429 (7.8%)
Occitanie	114 (7.1%)	16 (8.4%)	302 (8.2%)	432 (7.9%)
Pays de Loire	146 (9.1%)	21 (11.1%)	281 (7.6%)	448 (8.2%)
Provence Alpes Côte d'Azur	128 (8.0%)	15 (7.9%)	308 (8.3%)	451 (8.2%)
<i>Year of ICI initiation</i>				
2020-2021	841 (52.3%)	189 (99.5%)	1284 (34.7%)	2314 (42.1%)
2022	665 (41.3%)	0 (0%)	1881 (50.9%)	2546 (46.3%)
2023	103 (6.4%)	1 (0.5%)	531 (14.4%)	635 (11.6%)
<i>ICI regimen</i>				
Anti-PD1	25 (1.6%)	0 (0%)	42 (1.1%)	67 (1.2%)
Anti-PDL1	1582 (98.3%)	190 (100%)	3651 (98.8%)	5423 (98.7%)
Anti-PD1/CTLA4	2 (0.1%)	0 (0.0%)	3 (0.1%)	5 (0.1%)
<i>Metastatic cancer</i>	386 (24%)	42 (22.1%)	938 (25.4%)	1366 (24.9%)
<i>Poor performance status proxy</i>	104 (6.5%)	9 (4.7%)	354 (9.6%)	467 (8.5%)
<i>Volume of inclusion</i>				
high (top 10% centers)	313 (19.5%)	30 (15.8%)	738 (20.0%)	1081 (19.7%)
intermediate (10–40%)	562 (34.9%)	78 (41.1%)	1261 (34.1%)	1901 (34.6%)
low (bottom 60%)	734 (45.6%)	82 (43.2%)	1697 (45.9%)	2513 (45.7%)
<i>Major cancer surgery ≤3 years</i>	300 (18.6%)	23 (12.1%)	625 (16.9%)	948 (17.3%)
<i>Chemotherapy ≤3years</i>	264 (16.4%)	28 (14.7%)	599 (16.2%)	891 (16.2%)
<i>Radiotherapy ≤3years</i>	220 (13.7%)	21 (11.1%)	472 (12.8%)	713 (13%)
<i>Anti-angiogenic ≤3months</i>	1353 (84.1%)	171 (90%)	3023 (81.8%)	4547 (82.7%)
<i>≥7mg EQ-PRED <1month</i>	157 (9.8%)	13 (6.8%)	332 (9%)	502 (9.1%)
<i>Opioid ≤3 months</i>	496 (30.8%)	64 (33.7%)	1158 (31.3%)	1718 (31.3%)
<i>Antibiotic ≤3 months</i>	367 (22.8%)	40 (21.1%)	811 (21.9%)	1218 (22.2%)
<i>Antiepileptic ≤3 months</i>	30 (1.9%)	8 (4.2%)	69 (1.9%)	107 (1.9%)

<i>Bisphosphonate ≤3 months</i>	9 (0.6%)	1 (0.5%)	17 (0.5%)	27 (0.5%)
<i>Anti-RANKL ≤3 months</i>	9 (0.6%)	1 (0.5%)	15 (0.4%)	25 (0.5%)
<i>Proton pump inhibitors ≤3 months</i>	891 (55.4%)	94 (49.5%)	1932 (52.3%)	2917 (53.1%)
<i>Malnutrition ≤6 months</i>	165 (10.3%)	22 (11.6%)	503 (13.6%)	690 (12.6%)
<i>≥2 ambulance transports on separate days ≤6 months</i>	125 (7.8%)	10 (5.3%)	320 (8.7%)	455 (8.3%)
<i>≥1 emergency department visit ≤6 months</i>	472 (29.3%)	48 (25.3%)	1077 (29.1%)	1597 (29.1%)
<i>≥1 intensive care unit ≤6 months</i>	133 (8.3%)	12 (6.3%)	342 (9.3%)	487 (8.9%)
<i>≥1 at-home hospitalization ≤6 months</i>	10 (0.6%)	0 (0%)	34 (0.9%)	44 (0.8%)
<i>≥1 rehabilitation or long-term care ≤6 months</i>	34 (2.1%)	2 (1.1%)	102 (2.8%)	138 (2.5%)
<i>≥1 home nursing care visit ≤6 months</i>	22 (1.4%)	4 (2.1%)	80 (2.2%)	106 (1.9%)
<i>Home oxygen ≤6 months</i>	18 (1.1%)	1 (0.5%)	56 (1.5%)	75 (1.4%)
<i>≥1 palliative care stay ≤6 months</i>	29 (1.8%)	6 (3.2%)	99 (2.7%)	134 (2.4%)
<i>Heart Failure</i>	140 (8.7%)	13 (6.8%)	335 (9.1%)	488 (8.9%)
<i>COPD or emphysema</i>	200 (12.4%)	21 (11.1%)	493 (13.3%)	714 (13%)
<i>Respiratory failure</i>	145 (9%)	19 (10%)	393 (10.6%)	557 (10.1%)
<i>Diabetes</i>	805 (50%)	106 (55.8%)	1786 (48.3%)	2697 (49.1%)
<i>Obesity</i>	239 (14.9%)	35 (18.4%)	582 (15.7%)	856 (15.6%)
<i>Hypertension</i>	1324 (82.3%)	160 (84.2%)	2922 (79.1%)	4406 (80.2%)
<i>COVID-19 infection <100days</i>	43 (2.7%)	0 (0.0%)	311 (8.4%)	354 (6.4%)
<i>Any non-COVID-19 vaccine ≤1y before pre-ICI period</i>	1005 (62.5%)	131 (68.9%)	1999 (54.1%)	3135 (57.1%)
<i>GP consultations ≤6months</i>				
0-3 consultations	599 (37.2%)	38 (20.0%)	1394 (37.7%)	2031 (37.0%)
3-6 consultations	560 (34.8%)	71 (37.4%)	1252 (33.9%)	1883 (34.3%)
>6 consultations	450 (28.0%)	81 (42.6%)	1050 (28.4%)	1581 (28.8%)

Abbreviations: Anti-CTLA4: anti-cytotoxic T-lymphocyte-associated protein 4; anti-PD1: anti-programmed cell death protein 1; anti-PDL1: anti-programmed death-ligand 1; COPD: chronic obstructive pulmonary disease; EQ-PRED: equivalent prednisone; ICI: immune checkpoint inhibitor; IQR: interquartile range; Med: median; GP: General Practitioner; y: year

*Patients receiving both mRNA and non-mRNA COVID-19 vaccine (n=6) within 100 days before ICI start were included in the mRNA COVID-19 vaccine group.

Supplementary Table-7. Characteristics of the population at index date by vaccination status within 100 days before ICI initiation in metastatic cancers.

Variables	COVID-19 mRNA vaccine (≥1 dose)*	Non-mRNA COVID-19 vaccine (≥1 dose)*	No vaccine	Total
Number of patients	17,483	41,595	1,479	60,557
<i>Age (Med [IQR], years)</i>	68 [61;74]	66 [61;71]	67 [59;74]	67 [59;74]
<i>Sex (Men)</i>	11699 (66.9%)	26608 (64.0%)	1079 (73.0%)	39386 (65.0%)
<i>Low income (Yes)</i>	1284 (7.3%)	4410 (10.6%)	105 (7.1%)	5799 (9.6%)
<i>Deprivation index</i>				
1 (least deprivation)	3042 (17.4%)	209 (14.1%)	6652 (16.0%)	9903 (16.4%)
2	3330 (19.0%)	279 (18.9%)	7492 (18.0%)	11101 (18.3%)
3	3769 (21.6%)	329 (22.2%)	9343 (22.5%)	13441 (22.2%)
4	3781 (21.6%)	335 (22.7%)	8958 (21.5%)	13074 (21.6%)
5 (most deprivation)	3561 (20.4%)	327 (22.1%)	9150 (22.0%)	13038 (21.5%)
<i>Region of residence</i>				
Auvergne-Rhône Alpes	2073 (11.9%)	167 (11.3%)	4825 (11.6%)	7065 (11.7%)
Bourgogne Franche Comté	934 (5.3%)	61 (4.1%)	2131 (5.1%)	3126 (5.2%)
Bretagne	1134 (6.5%)	124 (8.4%)	2417 (5.8%)	3675 (6.1%)
Centre-Val de Loire	669 (3.8%)	64 (4.3%)	1560 (3.8%)	2293 (3.8%)
Corse	102 (0.6%)	4 (0.3%)	296 (0.7%)	402 (0.7%)
Grand Est	1423 (8.1%)	106 (7.2%)	3600 (8.7%)	5129 (8.5%)
Outre Mer	141 (0.8%)	4 (0.3%)	628 (1.5%)	773 (1.3%)
Hauts de France	1598 (9.1%)	184 (12.4%)	3732 (9.0%)	5514 (9.1%)
Ile de France	2331 (13.3%)	154 (10.4%)	5569 (13.4%)	8054 (13.3%)
Normandie	1060 (6.1%)	97 (6.6%)	2463 (5.9%)	3620 (6.0%)
Nouvelle Aquitaine	2049 (11.7%)	181 (12.2%)	4465 (10.7%)	6695 (11.1%)
Occitanie	1601 (9.2%)	161 (10.9%)	4224 (10.2%)	5986 (9.9%)
Pays de Loire	973 (5.6%)	100 (6.8%)	2076 (5.0%)	3149 (5.2%)
Provence Alpes Côte d'Azur	1395 (8.0%)	72 (4.9%)	3609 (8.7%)	5076 (8.4%)
<i>Year of ICI initiation</i>				
2020-2021	9041 (51.7%)	1473 (99.6%)	15497 (37.3%)	26011 (43.0%)
2022	7388 (42.3%)	5 (0.3%)	20329 (48.9%)	27722 (45.8%)
2023	1054 (6.0%)	1 (0.1%)	5769 (13.9%)	6824 (11.3%)
<i>ICI regimen</i>				
Anti-PD1	13034 (74.6%)	1083 (73.2%)	31264 (75.2%)	45381 (74.9%)
Anti-PDL1	3486 (19.9%)	313 (21.2%)	8162 (19.6%)	11961 (19.8%)
Anti-PD1/CTLA4	963 (5.5%)	83 (5.6%)	2169 (5.2%)	3215 (5.3%)
<i>Poor performance status proxy</i>	3632 (20.8%)	10434 (25.1%)	396 (26.8%)	14462 (23.9%)
<i>Volume of inclusion</i>				
high (top 10% centers)	1628 (9.3%)	4000 (9.6%)	126 (8.5%)	5754 (9.5%)
intermediate (10–40%)	5689 (32.5%)	12894 (31.0%)	452 (30.6%)	19035 (31.4%)
low (bottom 60%)	10166 (58.1%)	24701 (59.4%)	901 (60.9%)	35768 (59.1%)
<i>Major cancer surgery ≤3 years</i>	4917 (28.1%)	10484 (25.2%)	338 (22.9%)	15739 (26.0%)
<i>Chemotherapy ≤3years</i>	9269 (53.0%)	22670 (54.5%)	675 (45.6%)	32614 (53.9%)
<i>Radiotherapy ≤3years</i>	6719 (38.4%)	15588 (37.5%)	540 (36.5%)	22847 (37.7%)
<i>Anti-angiogenic ≤3months</i>	1425 (8.2%)	115 (7.8%)	3397 (8.2%)	4937 (8.2%)
<i>≥7mg EQ-PRED <1month</i>	7778 (44.5%)	18366 (44.2%)	667 (45.1%)	26811 (44.3%)
<i>Opioid ≤3 months</i>	7996 (45.7%)	19895 (47.8%)	776 (52.5%)	28667 (47.3%)
<i>Antibiotic ≤3 months</i>	6139 (35.1%)	15350 (36.9%)	519 (35.1%)	22008 (36.3%)
<i>Antiepileptic ≤3 months</i>	1006 (5.8%)	2544 (6.1%)	93 (6.3%)	3643 (6.0%)
<i>Bisphosphonate ≤3 months</i>	153 (0.9%)	362 (0.9%)	12 (0.8%)	527 (0.9%)

<i>Anti-RANKL ≤3 months</i>	551 (3.2%)	1011 (2.4%)	36 (2.4%)	1598 (2.6%)
<i>Proton pump inhibitors ≤3 months</i>	8755 (50.1%)	20938 (50.3%)	748 (50.6%)	30441 (50.3%)
<i>Malnutrition ≤6 months</i>	3408 (19.5%)	10337 (24.9%)	293 (19.8%)	14038 (23.2%)
<i>≥2 ambulance transports on separate days ≤6 months</i>	2370 (13.6%)	6589 (15.8%)	178 (12.0%)	9137 (15.1%)
<i>≥1 emergency department visit ≤6 months</i>	6582 (37.6%)	16943 (40.7%)	583 (39.4%)	24108 (39.8%)
<i>≥1 intensive care unit ≤6 months</i>	2623 (15.0%)	6851 (16.5%)	216 (14.6%)	9690 (16.0%)
<i>≥1 at-home hospitalization ≤6 months</i>	383 (2.2%)	1102 (2.6%)	17 (1.1%)	1502 (2.5%)
<i>≥1 rehabilitation or long-term care ≤6 months</i>	826 (4.7%)	2241 (5.4%)	39 (2.6%)	3106 (5.1%)
<i>≥1 home nursing care visit ≤6 months</i>	354 (2.0%)	1055 (2.5%)	17 (1.1%)	1426 (2.4%)
<i>Home oxygen ≤6 months</i>	800 (4.6%)	2091 (5.0%)	77 (5.2%)	2968 (4.9%)
<i>≥1 palliative care stay ≤6 months</i>	860 (4.9%)	2842 (6.8%)	60 (4.1%)	3762 (6.2%)
<i>Heart Failure</i>	1234 (7.1%)	2971 (7.1%)	92 (6.2%)	4297 (7.1%)
<i>COPD or emphysema</i>	3237 (18.5%)	7873 (18.9%)	327 (22.1%)	11437 (18.9%)
<i>Respiratory failure</i>	2177 (12.5%)	5711 (13.7%)	197 (13.3%)	8085 (13.4%)
<i>Diabetes</i>	3917 (22.4%)	9049 (21.8%)	384 (26.0%)	13350 (22.0%)
<i>Obesity</i>	1662 (9.5%)	3876 (9.3%)	165 (11.2%)	5703 (9.4%)
<i>Hypertension</i>	10319 (59.0%)	23579 (56.7%)	941 (63.6%)	34839 (57.5%)
<i>COVID-19 infection <100days</i>	543 (3.1%)	3514 (8.4%)	11 (0.7%)	4068 (6.7%)
<i>Any non-COVID-19 vaccine ≤1y before pre-ICI period</i>	8996 (51.5%)	858 (58.0%)	17424 (41.9%)	27278 (45%)
<i>GP consultations ≤6months</i>				
0-3 consultations	5763 (33.0%)	13743 (33.0%)	292 (19.7%)	19798 (32.7%)
3-6 consultations	5739 (32.8%)	13327 (32.0%)	508 (34.3%)	19574 (32.3%)
>6 consultations	5981 (34.2%)	14525 (34.9%)	679 (45.9%)	21185 (35.0%)

Abbreviations: Anti-CTLA4: anti-cytotoxic T-lymphocyte-associated protein 4; anti-PD1: anti-programmed cell death protein 1; anti-PDL1: anti-programmed death-ligand 1; COPD: chronic obstructive pulmonary disease; EQ-PRED: equivalent prednisone; ICI: immune checkpoint inhibitor; IQR: interquartile range; Med: median; GP: General Practitioner; y: year

*Patients receiving both mRNA and non-mRNA COVID-19 vaccine (n=51) within 100 days before ICI start were included in the mRNA COVID-19 vaccine group.

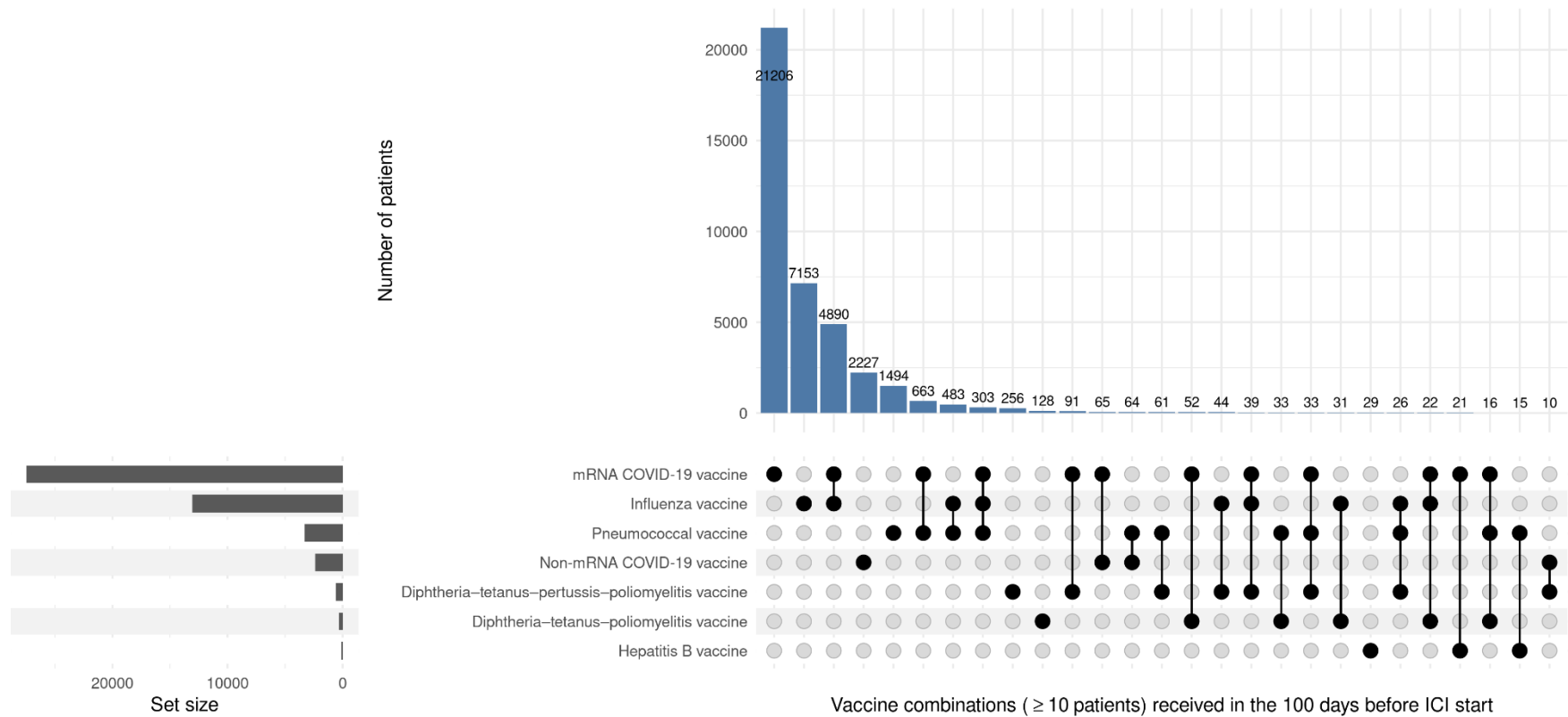
Supplementary Table-8. Survival probabilities and absolute survival differences at 1, 3, 6, 12 and 24 months between pre-ICI COVID-19 mRNA-vaccinated group vs. COVID-19 mRNA-unvaccinated group

Time (months)	Survival probability % (95% CI)		Absolute survival difference % (95% CI)
	COVID-19 mRNA vaccine	No COVID-19 vaccine	
1	94.6 (94.3–94.9)	94.1 (93.9–94.3)	0.5 (0.2-0.9)
3	86.0 (85.5–86.4)	84.5 (84.2–84.7)	1.5 (1.0-2.0)
6	75.6 (75.1–76.2)	74.1 (73.8–74.4)	1.5 (0.9-2.1)
12	60.2 (59.6–60.8)	58.9 (58.5–59.3)	1.3 (0.6-2.0)
24	43.5 (42.9–44.1)	42.5 (42.1–42.8)	1.0 (0.3-1.7)

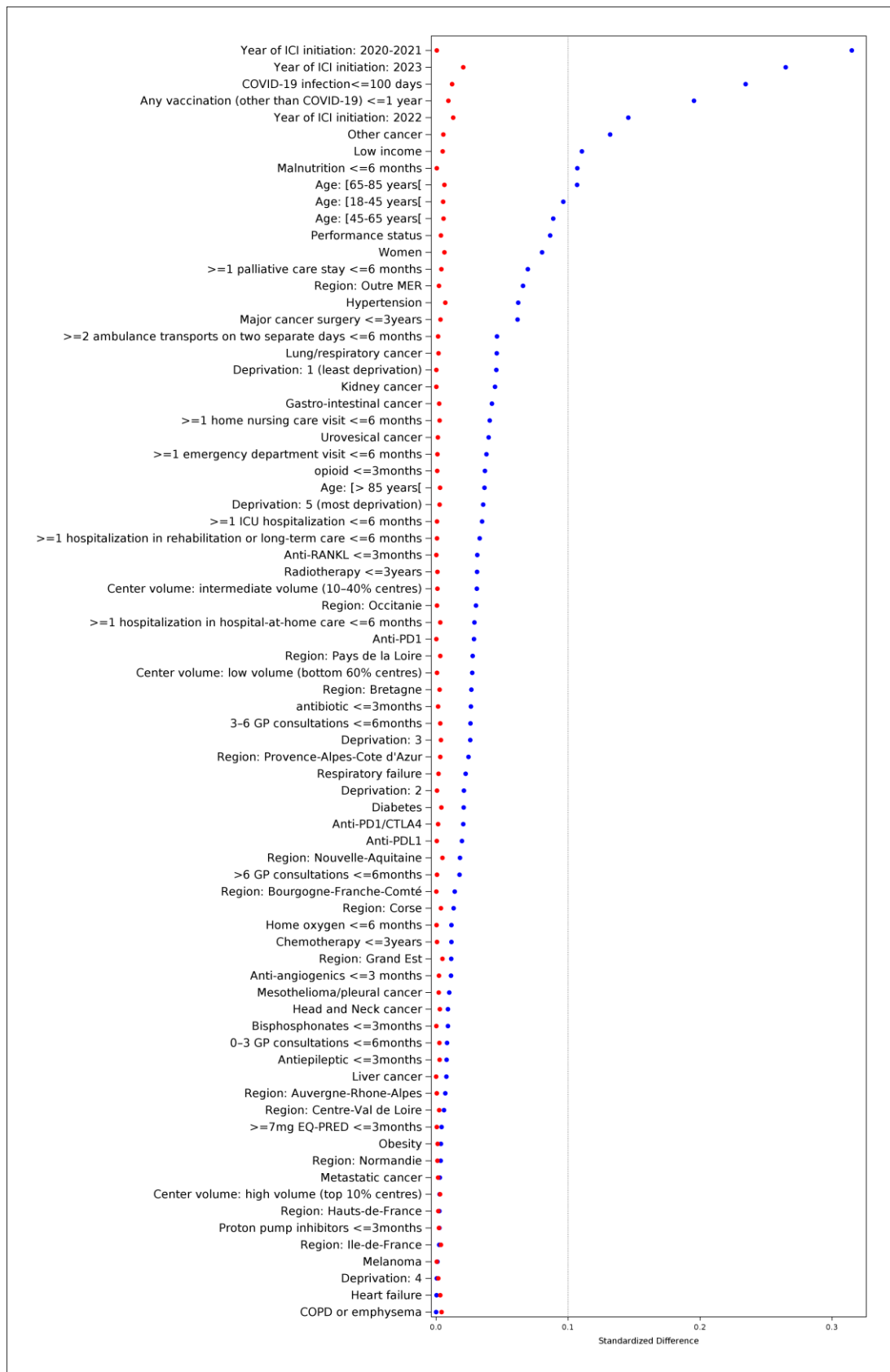
Supplementary Table-9. Survival probabilities and absolute survival differences at 3, 6, 12 and 24 months between post-ICI COVID-19 mRNA-vaccinated group vs. COVID-19 mRNA-unvaccinated group

Time (months)	Survival probability % (95% CI)		Absolute survival difference % (95% CI)
	COVID-19 mRNA vaccine	No COVID-19 vaccine	
3	84.2 (83.9-84.4)	83.6 (83.3-83.9)	0.5 (0.4-0.6)
6	75.4 (74.8-76.0)	72.5 (72.1-72.9)	2.9 (2.3–3.5)
12	60.6 (59.8-61.4)	57.2 (56.7-57.7)	3.4 (2.5–4.2)
24	43.9 (43.0-44.7)	41.3 (40.8-41.8)	2.6 (1.6–3.5)

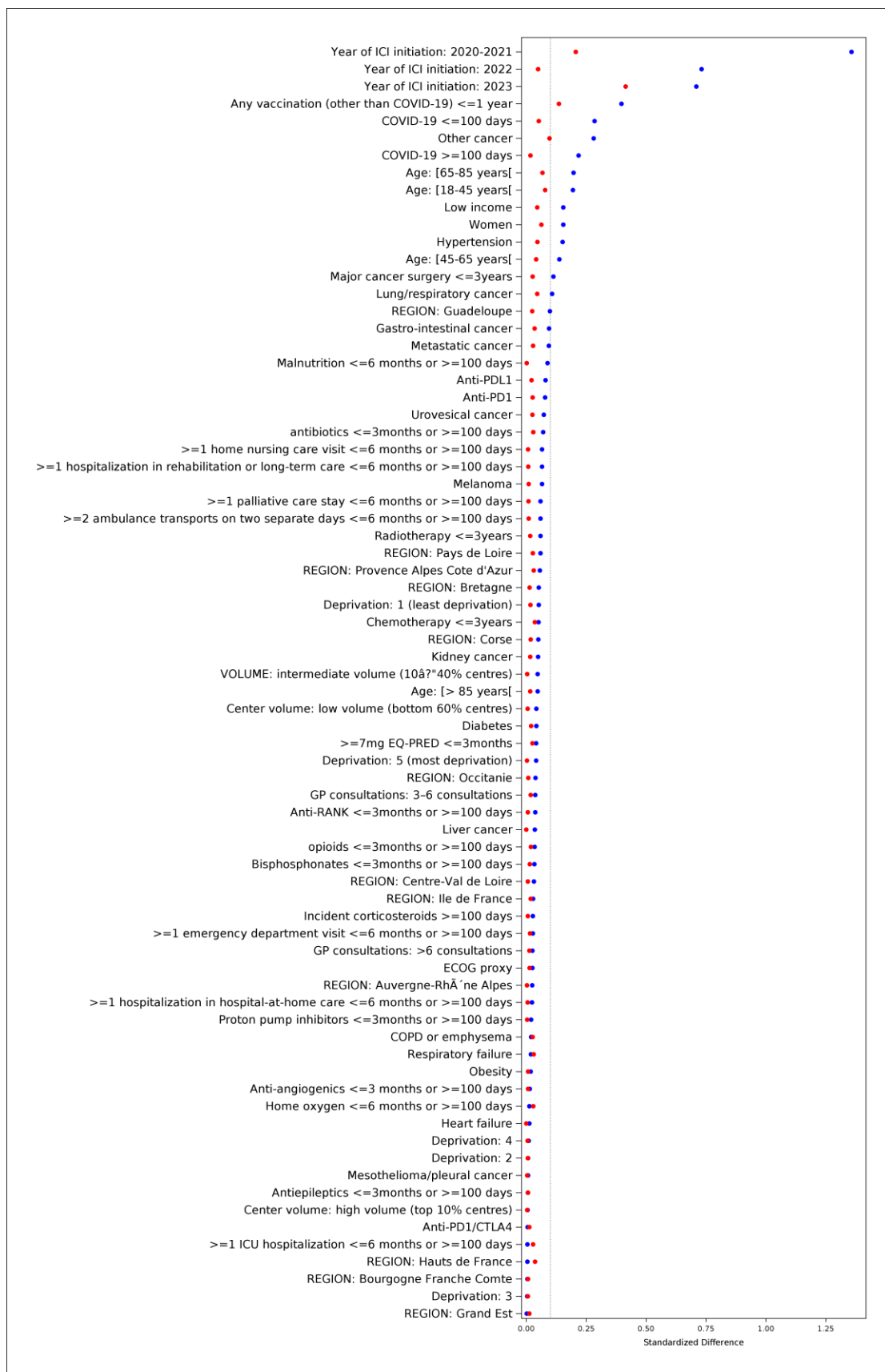
Supplementary Figure 1. Upset plot of vaccine overlaps in the 100 days before ICI start



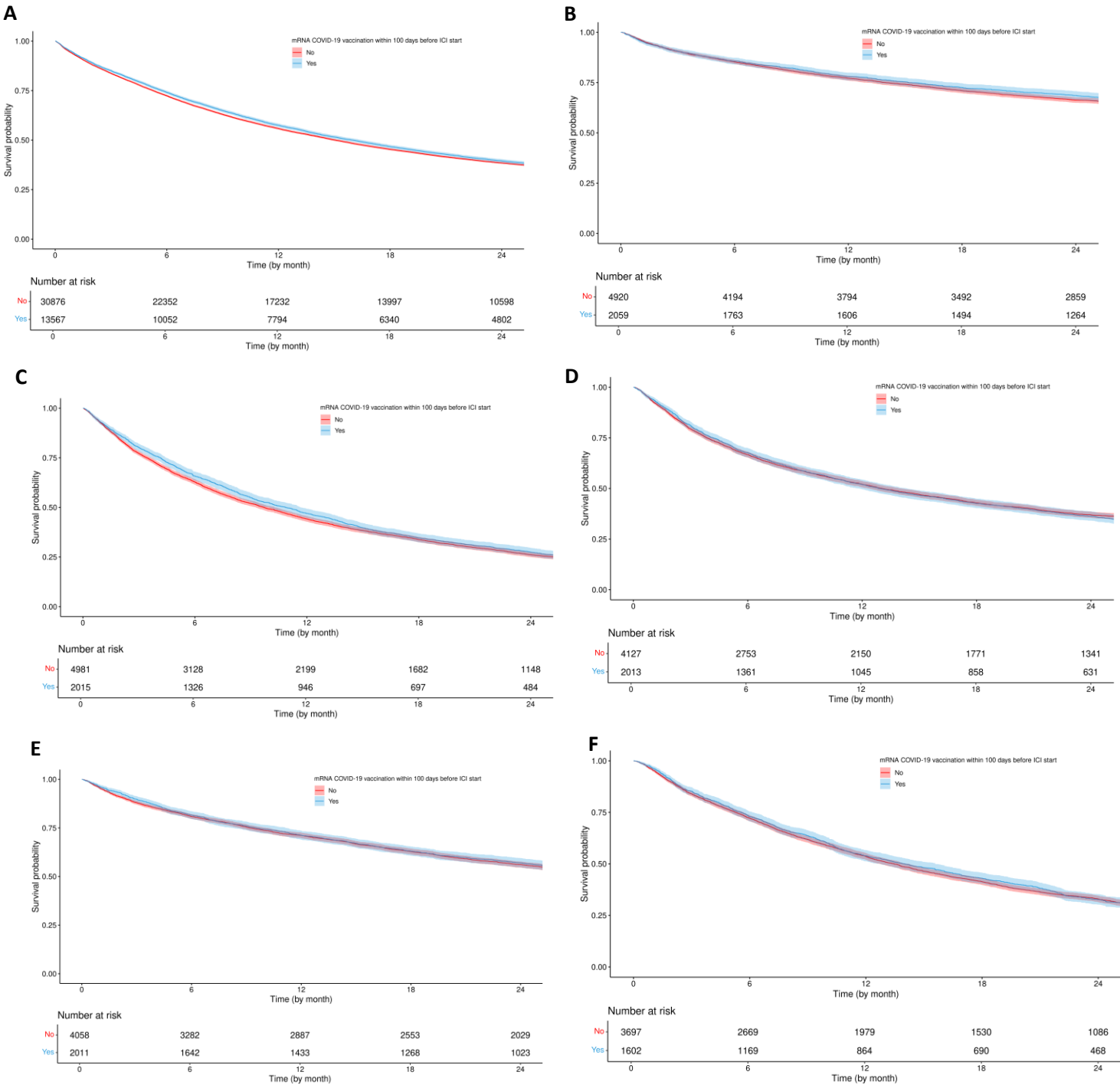
Supplementary Figure-2. Standardized mean differences before and after weighting in the pre-ICI analysis



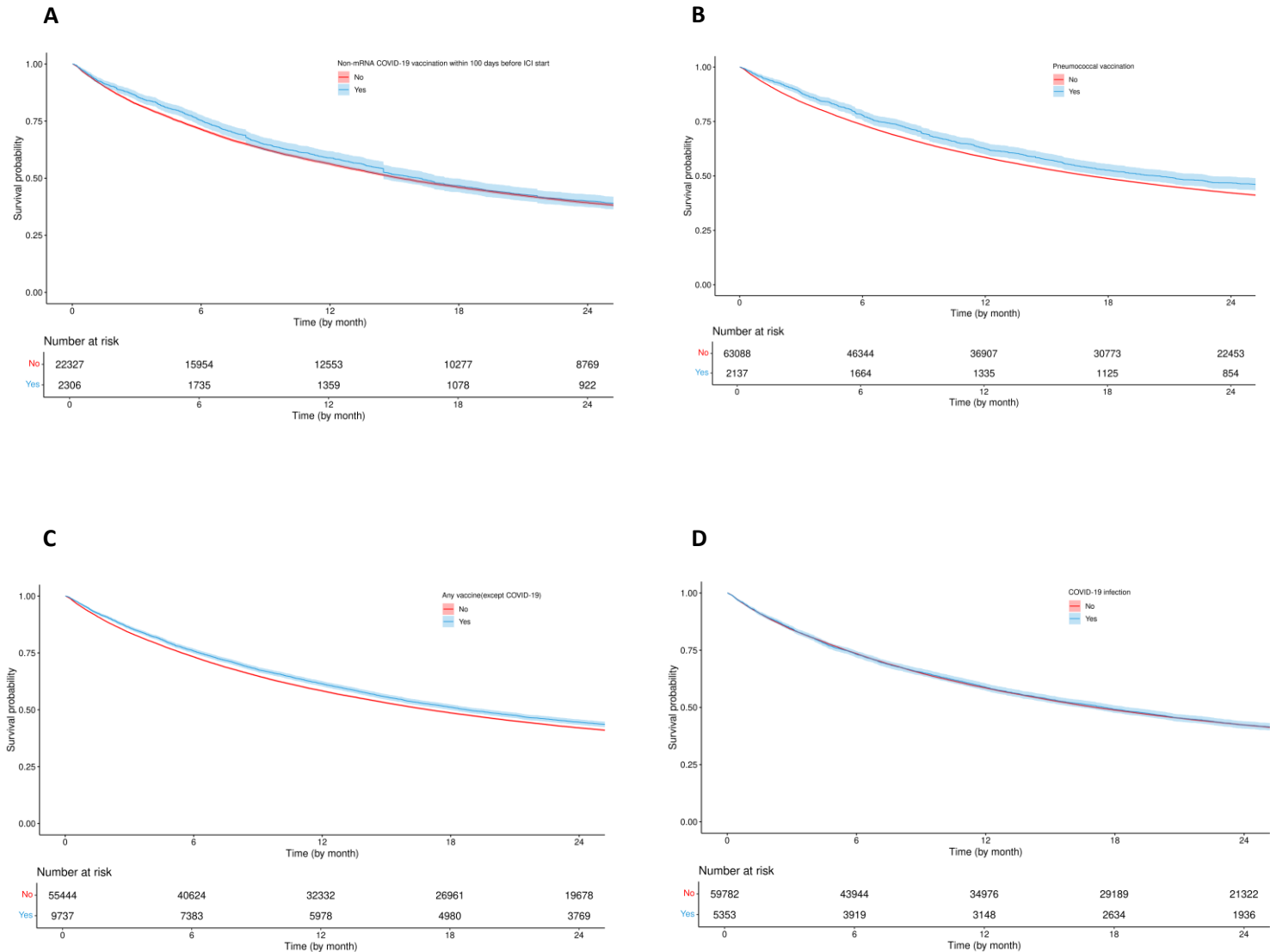
Supplementary Figure-3. Standardized mean differences at 100 days before and after weighting in the post-ICI analysis



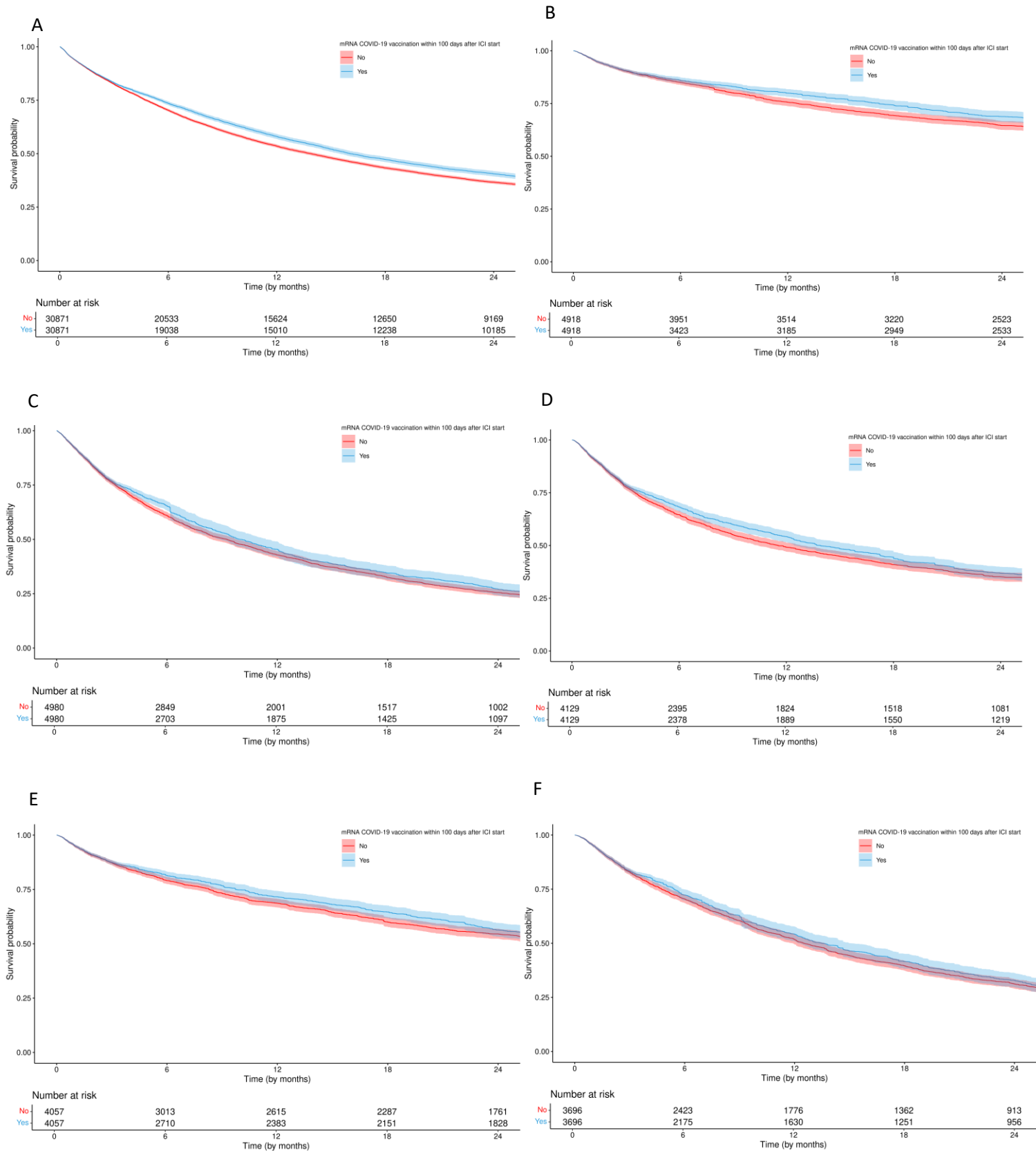
Supplementary Figure-4. Weighted survival curves of pre-ICI exposures and overall mortality by cancer type: lung/respiratory (A), melanoma (B), head and neck (C), urovesical (D), kidney (E), and liver cancers (F); numbers at risk displayed beneath the curves correspond to weighted patient counts.



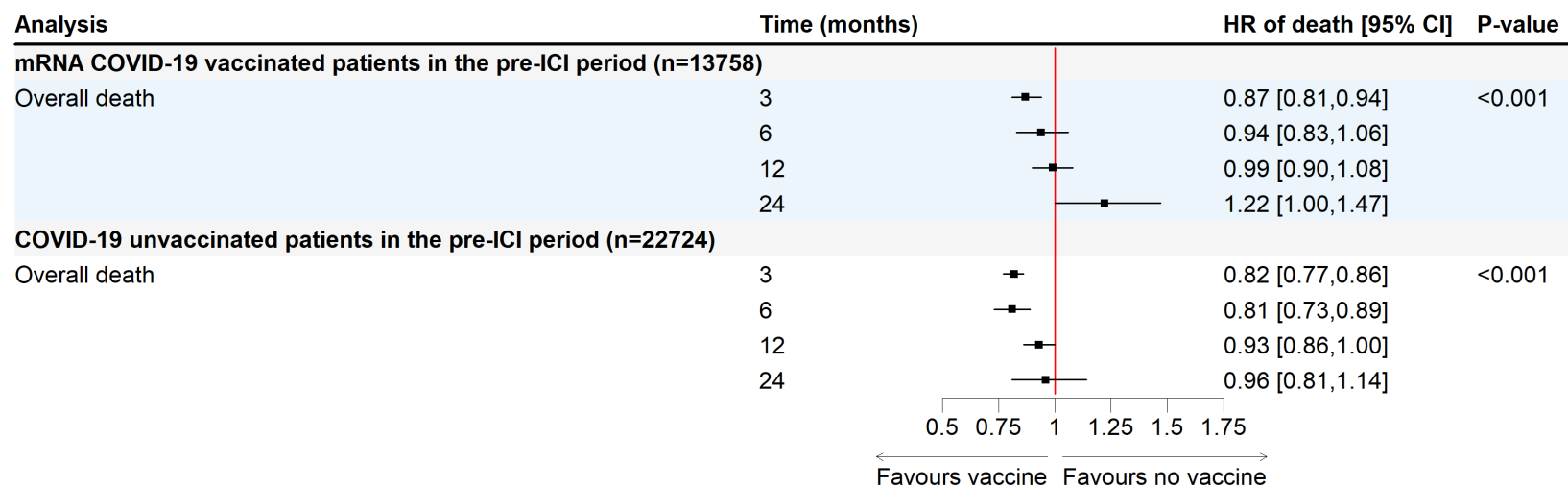
Supplementary Figure-5. Weighted survival curves (overall mortality) from secondary and sensitivity analyses of pre-ICI exposures: Non-mRNA-COVID-19 vaccination (A), pneumococcal vaccination (B), any non-COVID-19 vaccination (C), and documented COVID-19 infection (D); numbers at risk displayed beneath the curves correspond to weighted patient counts.



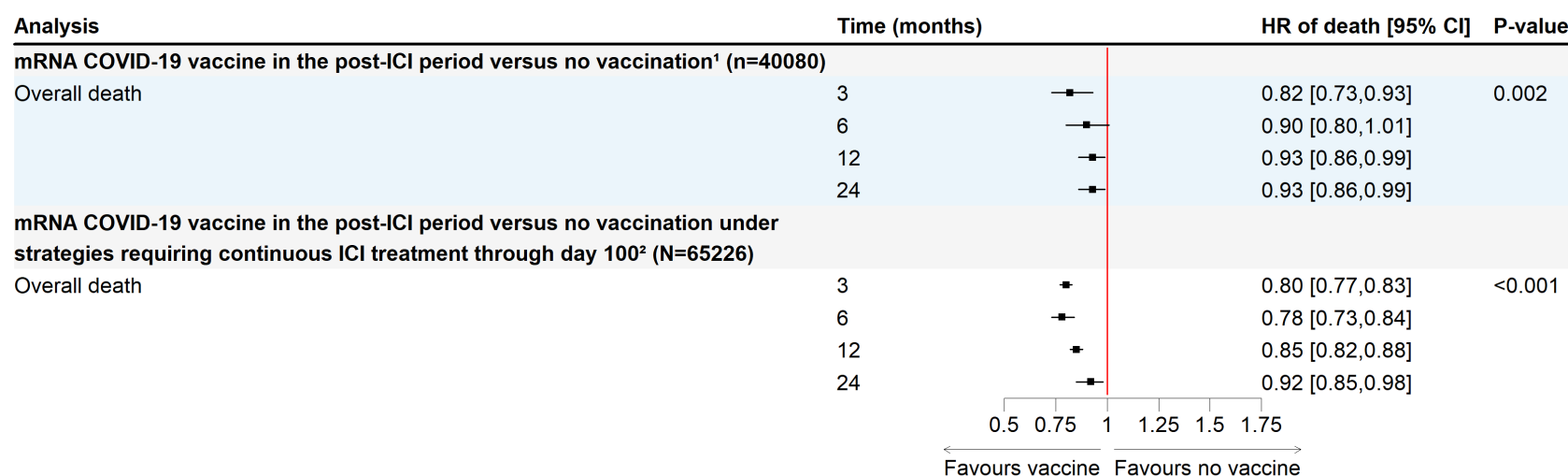
Supplementary Figure 6. Weighted survival curves of post-ICI exposures and overall mortality by cancer type: lung/respiratory (A), melanoma (B), head and neck (C), urovesical (D), kidney (E), and liver cancers (F). Under the CCW approach. each eligible patient is cloned at baseline into both strategies; numbers at risk are therefore similar in each arm.



Supplementary Figure-7. Association between post-ICI mRNA COVID-19 vaccination (vs. no) and overall survival, stratified by pre-ICI vaccination status in patients included in 2020–2021. Points represent hazard ratios (HRs). Horizontal lines represent 95% confidence intervals and the red vertical line corresponds to a HR of 1. Robust score tests were used to derive P values.



Supplementary Figure-8. Association between post-ICI mRNA COVID-19 vaccination (vs. no) and overall survival. The first analysis was performed among patients who were alive and still receiving ICI 100 days after initiation, and compared receipt of at least one dose of COVID-19 mRNA vaccine within the first 100 days after ICI initiation with no COVID-19 vaccination during the same period (index date= ICI initiation+100 days). The second analysis used the cloning-censoring-weighting approach as described in the post-ICI main analysis, and in addition censored (and weighted) at early ICI discontinuation. Points represent hazard ratios (HRs). Horizontal lines represent 95% confidence intervals and the red vertical line corresponds to a HR of 1. Robust score tests were used to derive P values.



¹Analysis performed among patients who had not received a COVID-19 vaccine before ICI initiation and was conditioned on being alive and on ICI treatment 100 days after ICI initiation (index date= ICI initiation+100 days).

²Analysis performed among patients who had not received a COVID-19 vaccine before ICI initiation and treatment strategies required continuous ICI treatment through day 100, taking into account censoring at ICI discontinuation during the first 100 days, in addition to censoring at deviation from the assigned vaccination group (index date= ICI initiation).

STROBE/RECORD-PE checklist.

Item No	STROBE items	RECORD(-PE) items	Location in article
1	(a) Indicate the study's design with a commonly used term in the title or the abstract.	1.1: The type of data used should be specified in the title or abstract. When possible, the name of the databases used should be included. 1.2: If applicable, the geographical region and timeframe within which the study took place should be reported in the title or abstract. 1.3: If linkage between databases was conducted for the study, this should be clearly stated in the title or abstract.	1(a): Study design is reported in the title. 1(b): An informative and balanced summary is provided in the Abstract. 1.1: The type of data used and the database are specified in the Abstract. 1.2: The geographical region and study timeframe are reported in the Abstract. 1.3: Not applicable; no data linkage was conducted.
Background rationale			
2	Explain the scientific background and rationale for the investigation being reported.	—	2: The scientific background and study rationale are described in the Introduction section.
Objectives			
3	State specific objectives, including any prespecified hypotheses.	—	3: The study objectives are described in the last paragraph of the Introduction section.
Methods			
Study design			
4	Present key elements of study design early in the paper.	4.a: Include details of the specific study design (and its features) and report the use of multiple designs if used. 4.b: The use of a diagram(s) is recommended to illustrate key aspects of the study design(s), including exposure, washout, lag and observation periods, and covariate definitions as relevant.	4: The overall study design is described in the Data Source and Study Overview sections. 4.a: Details of the specific study design and its key features are described in the Study Overview section. 4.b: No diagram was included; however, key aspects of the study design, including exposure definition, observation periods, and covariates, are reported in eTable 3 and eTable 4.
Setting			

5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection.	—	5: The study setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection, are reported in the Data Source, Study Population, and Study Overview sections.
Participants			
6	<p>(a) Cohort study—give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up. Case-control study—give the eligibility criteria, and the sources and methods of case ascertainment and control selection. Give the rationale for the choice of cases and controls. Cross sectional study—give the eligibility criteria, and the sources and methods of selection of participants.</p> <p>(b) Cohort study—for matched studies, give matching criteria and number of exposed and unexposed. Case-control study—for matched studies, give matching criteria and the number of controls per case.</p>	<p>6.1.a: Describe the study entry criteria and the order in which these criteria were applied to identify the study population. Specify whether only users with a specific indication were included and whether patients were allowed to enter the study population once or if multiple entries were permitted. See explanatory document for guidance related to matched designs.</p> <p>6.2: Any validation studies of the codes or algorithms used to select the population should be referenced. If validation was conducted for this study and not published elsewhere, detailed methods and results should be provided.</p> <p>6.3: If the study involved linkage of databases, consider use of a flow diagram or other graphical display to demonstrate the data linkage process, including the number of individuals with linked data at each stage.</p>	<p>6(a): Reported in the Data Source and Study Population sections.</p> <p>6(b): Not applicable.</p> <p>6.1: Codes and algorithms used to identify the study population are listed in eTable 1 and eTable 2.</p> <p>6.2: Validation studies were referenced when available.</p> <p>6.3: Not applicable.</p> <p>6.1.a: Study entry criteria and the order in which they were applied are described in the Study Population section and illustrated in Figure 1.</p>
Variables			
7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable.	7.1: A complete list of codes and algorithms used to classify exposures, outcomes, confounders, and effect modifiers should be provided. If these cannot be reported, an explanation should be provided.	<p>7: Outcomes and diagnostic criteria are described in the Outcome section; exposures are described in the Study Overview section; and potential confounders are described in the Covariates section.</p> <p>7.1: Codes and algorithms are listed in eTable 1 and eTable 2.</p> <p>7.1.a: The Study Overview section describes how drug exposure was defined.</p>

		<p>7.1.b: Specify the data sources from which drug exposure information for individuals was obtained.</p> <p>7.1.c: Describe the time window(s) during which an individual is considered exposed to the drug(s). The rationale for selecting a particular time window should be provided. The extent of potential left truncation or left censoring should be specified.</p> <p>7.1.d: Justify how events are attributed to current, prior, ever, or cumulative drug exposure.</p> <p>7.1.e: When examining drug dose and risk attribution, describe how current, historical or time on therapy are considered.</p> <p>7.1.f: Use of any comparator groups should be outlined and justified.</p> <p>7.1.g: Outline the approach used to handle individuals with more than one relevant drug exposure during the study period.</p>	<p>7.1.b: The Data Source section describes how drug exposure information was retrieved.</p> <p>7.1.c: The Study Overview section discusses the time window for drug exposure, and the Introduction section provides the rationale for the chosen time window.</p> <p>7.1.d: Information on prior or ever exposure to study drugs was not provided.</p> <p>7.1.e: Not applicable.</p> <p>7.1.f: The Study Overview section describes the comparator groups.</p> <p>7.1.g: The Study Overview section describes the approach used to handle multiple exposures.</p>
Data sources/measurement			
8	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group.	8.a: Describe the healthcare system and mechanisms for generating the drug exposure records. Specify the care setting in which the drug(s) of interest was prescribed.	<p>8: The Data Source section and eTable 2 describe how variables of interest were retrieved and defined. The same assessment methods were used for all study groups.</p> <p>8.a: The Data Source section describes how drug exposure was retrieved within the healthcare system; however, the care setting and the mechanisms for generating the exposure records were not reported and could be found elsewhere.</p>
Bias			
9	Describe any efforts to address potential sources of bias.	—	9: The Study Overview and Statistical Analysis sections describe the use of inverse probability of treatment

			weighting and a target-trial emulation framework (cloning–censoring–weighting) to address potential sources of bias.
Study size			
10	Explain how the study size was arrived at.	—	10: Not applicable, all available data were used.
Quantitative variables			
11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen, and why.	—	11: Statistical Analysis reported on use of quantitative variables.
Statistical methods			
12	<p>(a) Describe all statistical methods, including those used to control for confounding.</p> <p>(b) Describe any methods used to examine subgroups and interactions.</p> <p>(c) Explain how missing data were addressed.</p> <p>(d) Cohort study—if applicable, explain how loss to follow-up was addressed. Case-control study—if applicable, explain how matching of cases and controls was addressed. Cross sectional study—if applicable, describe analytical methods taking account of sampling strategy.</p> <p>(e) Describe any sensitivity analyses.</p>	<p>12.1.a: Describe the methods used to evaluate whether the assumptions have been met.</p> <p>12.1.b: Describe and justify the use of multiple designs, design features, or analytical approaches.</p>	<p>12(a): The Statistical Analysis section describes all statistical models used, including those used to control for confounding.</p> <p>12(b): The Statistical Analysis section reports subgroup analyses; time interactions are used to handle time dependent effects.</p> <p>12(c): Reported in Table 1.</p> <p>12(d): Not applicable.</p> <p>12(e): The Statistical Analysis section reports sensitivity analyses.</p> <p>12.1.a: The Statistical Analysis section reports methods used to evaluate whether model assumptions are met and how violations are handled.</p> <p>12.1.b: The Study Overview and Statistical Analysis sections justify the use of multiple designs and describe all analytical approaches used.</p>
Data access and cleaning methods			
12	—	<p>12.1: Authors should describe the extent to which the investigators had access to the database population used to create the study population.</p> <p>12.2: Authors should provide information on the data cleaning methods used in the study.</p>	<p>12.1: Data source reported who had access to the database.</p> <p>12.2: Data cleaning was limited to standard consistency checks and exclusion of records with invalid information, as routinely applied to SNDS data.</p>

Linkage			
12	—	12.3: State whether the study included person level, institutional level, or other data linkage across two or more databases. The methods of linkage and methods of linkage quality evaluation should be provided.	12.3: Person-level linkage between SNDS and mortality data was performed at the national level. Investigators did not perform the linkage, and detailed methods and linkage quality assessments are described elsewhere.
Results			
Participants			
13	(a) Report the numbers of individuals at each stage of the study (eg, numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed). (b) Give reasons for non-participation at each stage. (c) Consider use of a flow diagram.	13.1: Describe in detail the selection of the individuals included in the study (that is, study population selection) including filtering based on data quality, data availability, and linkage. The selection of included individuals can be described in the text or by means of the study flow diagram.	13(a): Reported in Figure 1, Figure 2 and Table 1. 13(b): Reported in Figure 1. 13(c): Reported in Figure 1. 13.1: Figure 1.
Descriptive data			
14	(a) Give characteristics of study participants (eg, demographic, clinical, social) and information on exposures and potential confounders. (b) Indicate the number of participants with missing data for each variable of interest. (c) Cohort study—summarise follow-up time (eg, average and total amount).	—	14(a): Reported in in results and Table 1. 14(b): Reported in Table 1. 14(c): Median follow-up was not reported; Only weighted median overall survival were provided in the Results section.
Outcome data			
15	Cohort study—report numbers of outcome events or summary measures over time. Case-control study—report numbers in each exposure category, or summary measures of exposure. Cross sectional study—report numbers of outcome events or summary measures.	—	15: Reported in results and Figure 3, Figure 5 and Supplementary Tables 7 and 8 .
Main results			
16	(a) Give unadjusted estimates and, if applicable, confounder adjusted estimates and their precision	—	16(a): Only weighted estimates with 95% confidence intervals are reported in the Results section . The same

	(eg, 95% confidence intervals). Make clear which confounders were adjusted for and why they were included. (b) Report category boundaries when continuous variables are categorised. (c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period.		confounders were used across all analyses and are listed in the Covariates section of the Methods. 16(b): Not applicable. 16(c): Survival differences are reported as absolute survival differences in supplementary tables 8 and 9.
Other analyses			
17	Report other analyses done—eg, analyses of subgroups and interactions, and sensitivity analyses.	—	17: Results section, Figure 3, 4 and 5, and supplementary Figures 4, 5, 6, 7 and 8 reported all secondary and sensitivity analysis.
Discussion			
Key results			
18	Summarise key results with reference to study objectives.	—	18: first paragraph of the Discussion summarizes key results.
Limitations			
19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias.	19.1: Discuss the implications of using data that were not created or collected to answer the specific research question(s). Include discussion of misclassification bias, unmeasured confounding, missing data, and changing eligibility over time, as they pertain to the study being reported. 19.1.a: Describe the degree to which the chosen database(s) adequately captures the drug exposure(s) of interest.	19: Reported in Interpreting the association: infection prevention, non-specific effects, and anti-tumor synergy and the Limitations section. 19.1: The Discussion section mentions potential unmeasured confounding and misclassification bias. 19.1.a: Not reported.
Interpretation			
20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence.	20.a: Discuss the potential for confounding by indication, contraindication or disease severity or selection bias (healthy adherer/sick stopper) as alternative explanations for the study findings when relevant.	20: Reported in the Interpreting the Association and Clinical Implications sections. 20.a: Reported in the Interpreting the Association section.

Generalisability			
21	Discuss the generalisability (external validity) of the study results.	—	21: Generalisability is reported in the Limitations section.
Other information			
Funding			
22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based.	—	22: No funding.
Accessibility of protocol, raw data, and programming code			
22	—	22.1: Authors should provide information on how to access any supplemental information such as the study protocol, raw data, or programming code.	22.1: Not reported for the study protocol and not applicable for SNDS data and programming code.

RECORD=reporting of studies conducted using observational routinely collected data; RECORD-PE=RECORD for pharmacoepidemiological research; STROBE=strengthening the reporting of observational studies in epidemiology.

*[REFERENCE: Langan SM, Schmidt S, Wing K, Ehrenstein V, Nicholls S, Filion K, Klungel O, Petersen I, Sorensen H, Guttman A, Harron K, Hemkens L, Moher D, Schneeweiss S, Smeeth L, Sturkenboom M, von Elm E, Wang S, Benchimol EI. The REporting of studies Conducted using Observational Routinely-collected health Data \(RECORD\) Statement for Pharmacoepidemiology \(RECORD-PE\). *BMJ* 2018; 363: k3532.](#)